SCHOOL OF CIVIL ENGINEERING

INDIANA DEPARTMENT OF HIGHWAYS

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ENGINEERING SOILS MAP OF LAWRENCE COUNTY, INDIANA

F. T. Adams

PURDUE UNIVERSITY

Final Report

ENGINEERING SOILS MAP OF LAWRENCE COUNTY, INDIANA

by

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Purdue University
West Lafayette, Indiana
May 1, 1984

Final Report

ENGINEERING SOILS MAP OF LAWRENCE COUNTY, INDIANA

TO: H. L. Michael, Director
Joint Highway Research Project

May 1, 1984

Project: C-36-51B

FROM: R. D. Miles

File: 1-5-2-66

Attached is the Final Report on the "Engineering Soils Map of Lawrence County, Indiana." The map and report have been prepared by Mr. Francis T. Adams, Graduate Assistant on our staff under the direction of Professor Robert D. Miles.

This is another county map which has been completed by using aerial photography and available information. The map and report should be very useful in planning and developing engineering facilities in Lawrence County.

The Report is presented to the Board as a final report showing completion of the Lawrence County engineering soils mapping project.

Sincerely,

Robert D. Miles

Robert D. Miles

RDM/rrw

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In addition, the author is indebted to the other students with whom he had the pleasure of working on the county soil mapping project, including Ed Gefell, Andy Huang, and Leo Frey. Special recognition should be given to Patty Cullen for her excellent work in drafting the engineering soils map (a first for both of us) and most of the illustrations in this report. Debra Gonzales drafted the stratagraphic column.

All airphotos used in connection with the preparation of this report were obtained by the Indiana Department of Highways and the United States Department of Agriculture.

ENGINEERING SOILS MAP

OF

LAWRENCE COUNTY, INDIANA

Introduction

The engineering soils map of Lawrence County, Indiana, which accompanies this report, was prepared primarily by interpretation of aerial photographs. Additional information was obtained from the bedrock geology map of the Vincennes Quadrangle (1).* A recently published agricultural soil survey for the county was unavailable, but the 1928 county soil report (2) was consulted. Unpublished material for an up-to-date agricultural survey was provided by the Soil Conservation Service office in Indianapolis and was used to compile the subsurface profiles (3). A reconnaissance trip clarified soil boundaries that were difficult to identify from the airphotos. The aerial photographs were taken in December 1976 for the U. S. Department of Agriculture and have an approximate scale of 1:24,000.

Aerial photographic interpretation of the landforms, parent materials, and soil textures was done according to accepted principles of observation (4). Difficulty in delineating the boundaries of residual soil derived from the various bedrock types in the county required use of the geologic map in conjunction with

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* Numbers in parenthesis refer to Bibiliography

the airphotos. The engineering soils map identifies physiographic landforms, and groups the soils according to parent material, which correlates with general engineering behavior.

Standard symbols developed by the staff of the Airphoto Interpretation Laboratory in the School of Civil Engineering at Purdue University, were used to identify landform-parent material associations and soil textures on the engineering soils map. This report elaborates on the soil conditions encountered in the county as presented on the accompanying map, and attempts to overcome the limitations imposed by strict adherence to a standard map symbolism.

The map and report are part of a continuing effort to complete a comprehensive engineering soil survey for each county in Indiana. A consistent mapping of soil units at the boundaries with previously mapped Monroe and Jackson Counties is attempted. Some small areas are not reconciled, but the discrepancies are minor.

Also included on the map is a set of subsurface profiles for each engineering soil unit. They show approximate variations that are expected in the general soil profile, and are compiled from the Soil Conservation Service information for Lawrence County and from the Monroe County Soil Survey report (5). Extensive boring information is available from the Indiana Geotechnical Data Bank for site investigations conducted along highways S.R. 37, S.R. 446, S.R. 158, S.R. 54, S.R. 450, and U.S.

50, and is presented in Appendices A and B. Boring locations are shown on the map. Additional information for the profile development is found in Reference (6).

The predominant agricultural soils associated with each landform-parent material class are included in the discussion of the engineering soil units of the county. General engineering data for each of these soil series is listed in Appendix C.

This report is in the standard format as previous county soils reports. Additional investigtion into special problems encountered in limestone regions, using Lawrence County as a study area, is being conducted, and will be incorporated into a second report.

Description of the Area

General

Lawrence County is located in south-central Indiana as shown in Figure 1. It is bounded by Monroe County on the north, Jackson and Washington Counties on the east, Orange County on the south, and Martin and Greene Counties on the west. The county is approximately square in shape, 21 miles north-south and 22 miles east-west, with an area of 452 square miles (1171 sq. km). Total population according to the 1980 Census (7) is 42,472, with 23,421 (55.1 percent) residing in rural areas. Bedford is the county seat, with a population of 14,410, and is centrally located.

Figure 1. Location Map of Lawrence County.

The 1974 U. S. Agricultural Census (8) indicates that about 178,000 of the 294,000 acres is classified as farmland. About 54 percent is cropland, 26 percent is wooded, and the remainder is in pasture. Numerous limestone quarries provide an additional income for the county. Bedford limestone (also referred to as Indiana limestone) is an excellent building material and is used in several famous structures such as the Empire State Building in New York City and the National Archives and Pentagon Buildings in Washington D. C.

Climate

The climate of Lawrence County is described as continental, which is characterized by well-marked seasonal changes in temperature, with relatively hot summers and rather cold winters. Abrupt daily changes in temperature are common (9). Average annual precipitation is about 45 in. (114 cm), while the average daily temperature ranges from 32°F in January to 76°F in July. The expected yearly snowfall is 21 in. (53 cm). Other climatological data compiled at Oolitic for the period 1936-1965 (10) is presented in Table 1.

Physiography

The physiographic map of Indiana, shown in Figure 2, reveals that three subsections are found in Lawrence County: the Norman Upland, the Mitchell Plain, and the Crawford Upland. They are part of the Highland Rim Section of the Interior Low Plateaus Province (11). The Norman Upland, covering approximately the

Table 1. Temperature and Precipitation Data for Oolitic Station in Lawrence County, Indiana*

MONTH	TEMPERATURE (°F)					PRECIPITATION TOTALS (INCHES)					MEAN NUMBER OF DAYS PRECIP. .10 OR MORE
	MEANS			EXTREMES				SNOW AND SLEET			
	DAILY MAXIMUM	DAILY MINIMUM	MONTHLY	RECORD HIGHEST	RECORD LOWEST	MEAN	GREATEST DAILY	MEAN	MAXIMUM MONTHLY	GREATEST DAILY	
January	41.0	22.5	31.8	75	-20	4.18	4.15	6.1	18.3	10.2	7
February	44.9	24.9	34.9	73	-18	3.26	3.21	4.6	18.2	9.0	7
March	54.6	32.5	43.6	84	- 6	4.72	4.20	4.5	23.4	9.0	9
April	67.4	42.6	55.0	90	20	4.20	4.01	0.5	3.0	3.0	8
May	77.5	51.7	64.6	96	28	4.59	2.68	Trace	0	0	8
June	85.4	60.7	73.1	108	39	4.95	3.14	0	0	0	7
July	88.5	63.9	76.2	110	45	3.99	2.90	0	0	0	7
August	88.3	62.6	75.5	109	42	3.19	2.74	0	0	0	5
September	81.2	55.0	68.1	105	28	3.09	3.00	0	0	0	5
October	70.7	44.5	57.6	92	18	2.46	2.96	T	T	T	5
November	54.8	33.3	44.1	83	- 3	3.53	2.85	1.4	9.0	9.0	6
December	43.2	25.0	34.1	72	- 9	3.22	2.39	4.4	12.8	6.0	7
Year	66.5	43.3	54.9	110	-20	45.38	4.20	21.0	23.4	10.2	81

*Latitude 38°53'N; Longitude 86°33'W; Elevation 650 ft. Data compiled for Period 1936-1965 (Ref. (10))

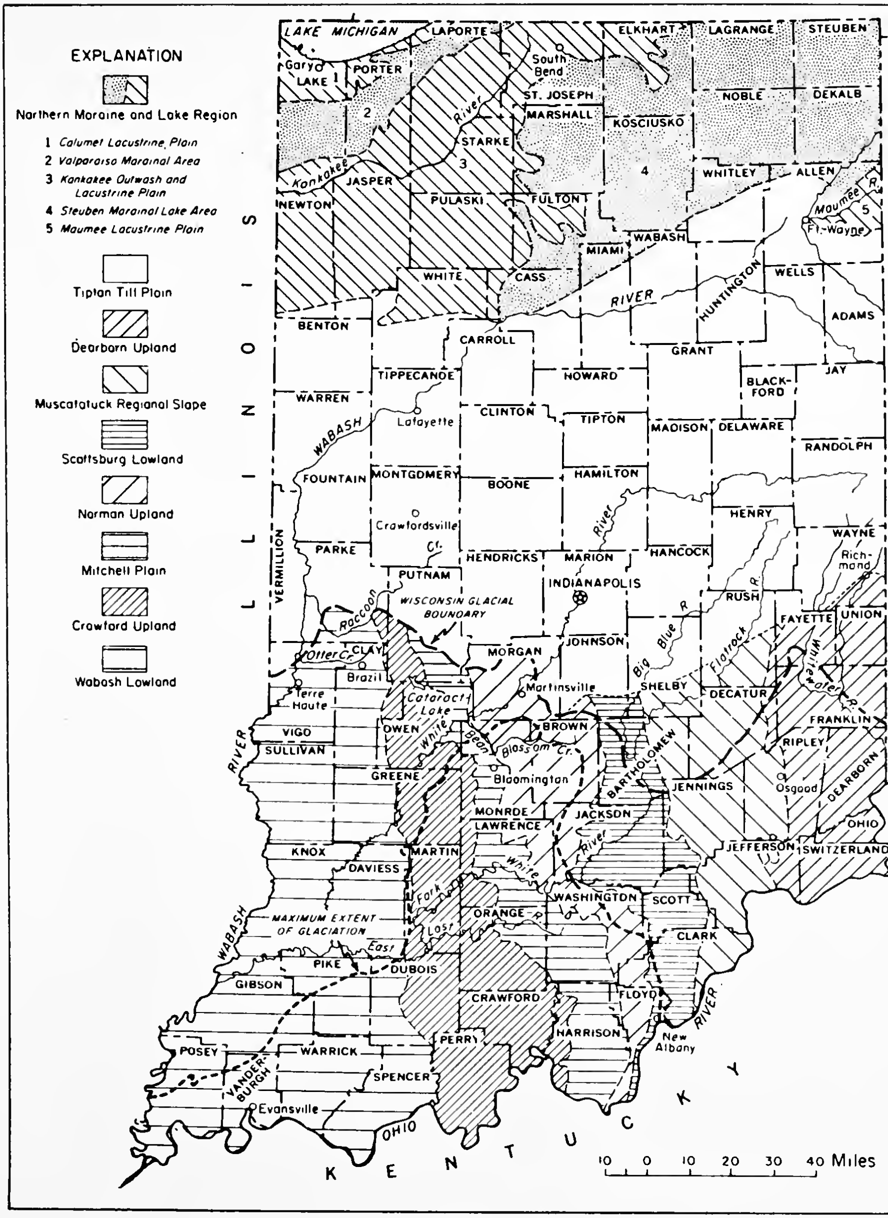


Figure 2. Physiographic Map of Indiana.
(After Reference (12))

eastern third of the county, is composed of siltstone, shale, and sandstone and is characterized by a rough topography. The western boundary is difficult to define since the upland merges with the limestone of the Mitchell Plain to the west. The divides consist of the younger limestone, while the valleys have the characteristics of the Norman Upland, though they are well within the general area of the adjacent limestone plain.

The Mitchell Plain exhibits a flat westward-dipping slope of about 20 ft per mile (3.8 m per km). A sinkhole plain is well-developed south of the East Fork White River, but becomes narrower and more irregular to the north. West of this karst plain is the Crawford Upland, composed mostly of interbedded sandstone and shale with some limestone. The area exhibits locally rough topography where the shale hills are severely eroded. Many of the ridges are capped by hard sandstone, and deeply incised karst valleys are common. The entire upland rises approximately 150 ft (46 m) above the adjacent limestone plain. (Summarized from Reference (13))

Drainage Features

Lawrence County lies entirely within the East Fork subdivision of the White River drainage basin (14). The major features are illustrated on the 1953 drainage map of the county shown in Figure 3. Drainage characteristics are influenced by the physiographic conditions encountered in the area and form three distinct patterns. Features are highly developed in the Norman

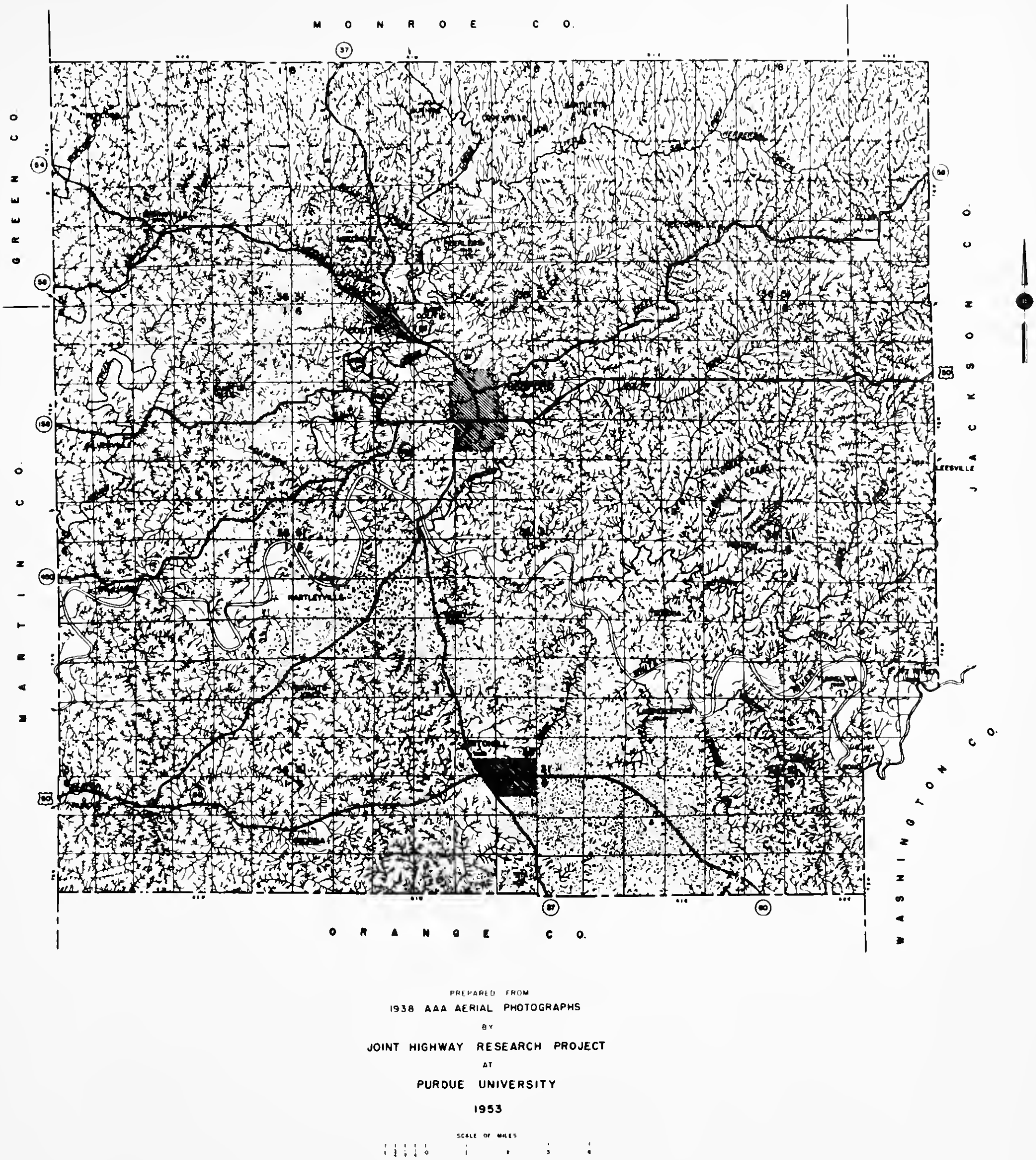


Figure 3. Drainage Map of Lawrence County.
(From Reference (14))

Upland portion of the county. Drainage patterns have a relatively fine-textured rectangular form due to the intensive weathering of the shale hills. Lower order streams exhibit a fine rectangular pattern while the higher order streams are angular, showing the effects of joint control. The lower part of Guthries Creek is strongly influenced by a resistant sandstone and shale ridge, and nearly parallels the East Fork White River for several miles before their junction.

The Mitchell Plain exhibits classic karst development with little surface drainage. Swallow-hole type drainage is especially developed in the western portion. Salt Creek is an old glacial sluiceway that carved deeply into the underlying bedrock and shows the effects of rock control. There is an obvious lack of surface drainage from the south into the East Fork White River. Springs are common along the main streams throughout the limestone plain. The courses of many of the natural streams are interrupted by quarrying operations.

Streams passing through the Crawford Upland show meandering courses, and the drainage is rectangular throughout the section. Indian Creek exhibits bedrock control. It disappears into a subterranean cutoff in the western part of the county (Sections 8 and 9, T5N, R2W), and re-emerges before flowing into Martin County, where it eventually joins the East Fork White River (13). Sinkholes are evident in the many karst benches in valleys found between the eroded shale and sandstone hills. Surface streams are conspicuously absent in these areas. Beaver Valley, located

south of the river, is a good example of a well developed karst valley.

The East Fork White River Valley is gorge-like, but rather narrow throughout the entire county. The river is very meandering and exhibits strong bedrock control. The fluvial deposits are very deep and much of the underlying material was washed into both the White River and Salt Creek valleys during melting of the Wisconsin glaciers. No natural lakes are found within the county. A small dammed reservoir is found near the headwaters of a tributary of Crawford Creek in Section 36, T5N, R1E just north of Pinhook. Small karst lakes are numerous, as are ponds of various origins. Some of the abandoned limestone quarries form small lakes.

Topography

The topography of Lawrence County is very rough in the Crawford and Norman Upland subsections and is described as rolling with many depressions in the Mitchell Plain. Total relief difference in the county is about 430 ft (131 m). Elevations above sea level range from 470 ft (143 m) in the East Fork White River valley to almost 900 ft (274 m) on the highest uplands (13). The topographic map of Lawrence County is shown in Figure 4.

The East Fork White River valley is relatively flat-bottomed with steep-sided valley walls. Bluffs of up to 250 ft (76 m) in height are common. Sandy terraces are found throughout the

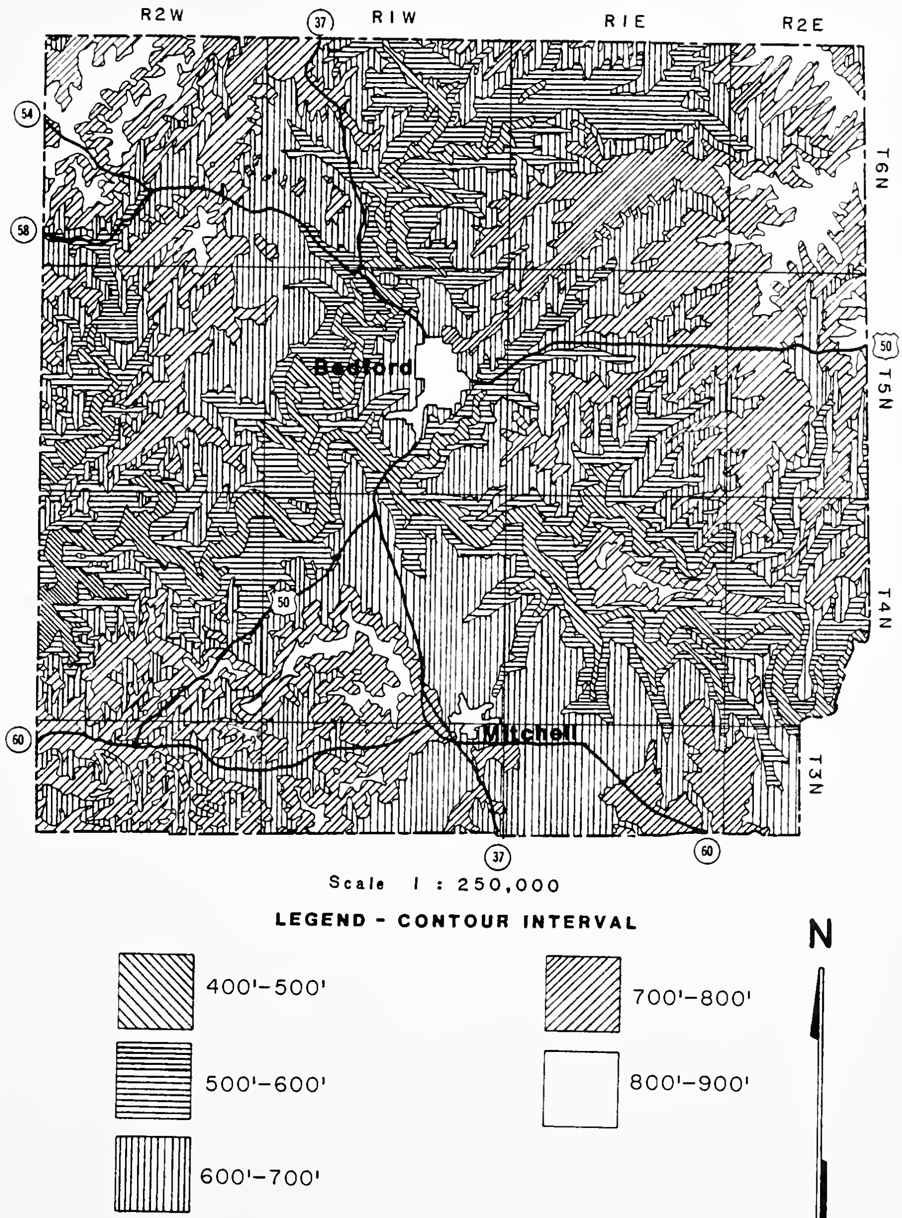


Figure 4. Topographic Map of Lawrence County. (After Reference (15))

valley. The lowest bottom lands exhibit a surface elevation of 470 ft (143 m) while the terraces range in elevation up to about 500 ft (152 m). In areas where eolian action occurs, rounded hills of coarse material are found.

The lacustrine plain which covers much of the lower Salt Creek valley is about 500 ft (152 m) above sea level. A portion of the plain forms a hummocky terrace over limestone at the confluence of Salt Creek and the East Fork White River in Sections 31 and 32, T5N, R1W. The elevation ranges from about 510 to 540 ft (155 to 165 m). The surrounding limestone uplands are rolling with an average elevation of between 600 and 700 ft (183 and 213 m). Numerous sinkholes and depressions up to about 50 ft (15 m) in depth dot the landscape giving the Mitchell Plain a classic karst topography. The walls of the major stream valleys in the limestone plain are moderately steep and show a scalloped effect as they intersect the flat bottomlands.

The Norman Upland is very rugged and has some of the most inaccessible areas in the county. The ridgetops are crested with deep narrow valleys 150 to 200 ft (46 to 61 m) deep. Many of the ridgetop elevations exceed 800 ft (244 m), with a few higher than 890 ft (271 m). The highest point in the county is elevation 891 ft (272 m) near the northeast corner of Section 4, T6N, R2E. The Crawford Upland rises 150 to 200 ft (46 to 61 m) above the Mitchell Plain and many hill crests exceed 800 ft (244 m) in elevation. The ridges are crested with flat narrow tops of sandstone, while the valleys are deep and generally flat-bottomed

when they extend into the underlying limestone. The flood plain of Indian Creek is about 500 ft (152 m) in elevation, with numerous rock-defended terraces of elevation 510 to 530 ft (155 to 162 m).

Bedrock Geology

The bedrock of the region significantly influences the surficial geology of this part of southern Indiana. Rock units are grouped into three types, corresponding to the three physiographic subsections found in the county, as illustrated by the geologic map shown in Figure 5. The Norman Upland contains the oldest rock in the county, interbedded siltstone, shale, sandstone, and some limestone of the Borden Group of Mississippian Age. The significant member is the New Providence Shale which erodes readily to form a very rugged topography. The ridgetops are often capped by the interbedded shale and sandstone of the Carwood and Locust Point Formations and the shale, sandstone, and limestone of the Muldraugh Formation. Figure 6 presents a columnar section showing the bedrock units found in the county.

The Mt. Carmel Fault is a major structural feature which runs through the northeastern part of the county in a north-northwest direction (see Figure 5). It is a normal dip-slip fault with an approximate dip of 69°W. The eastern block is upthrown with respect to the western side. Vertical displacement is estimated at between 80 and 175 ft (24 and 53 m) (16). Faulting most likely occurred during the late Valmeyer or early Ches-

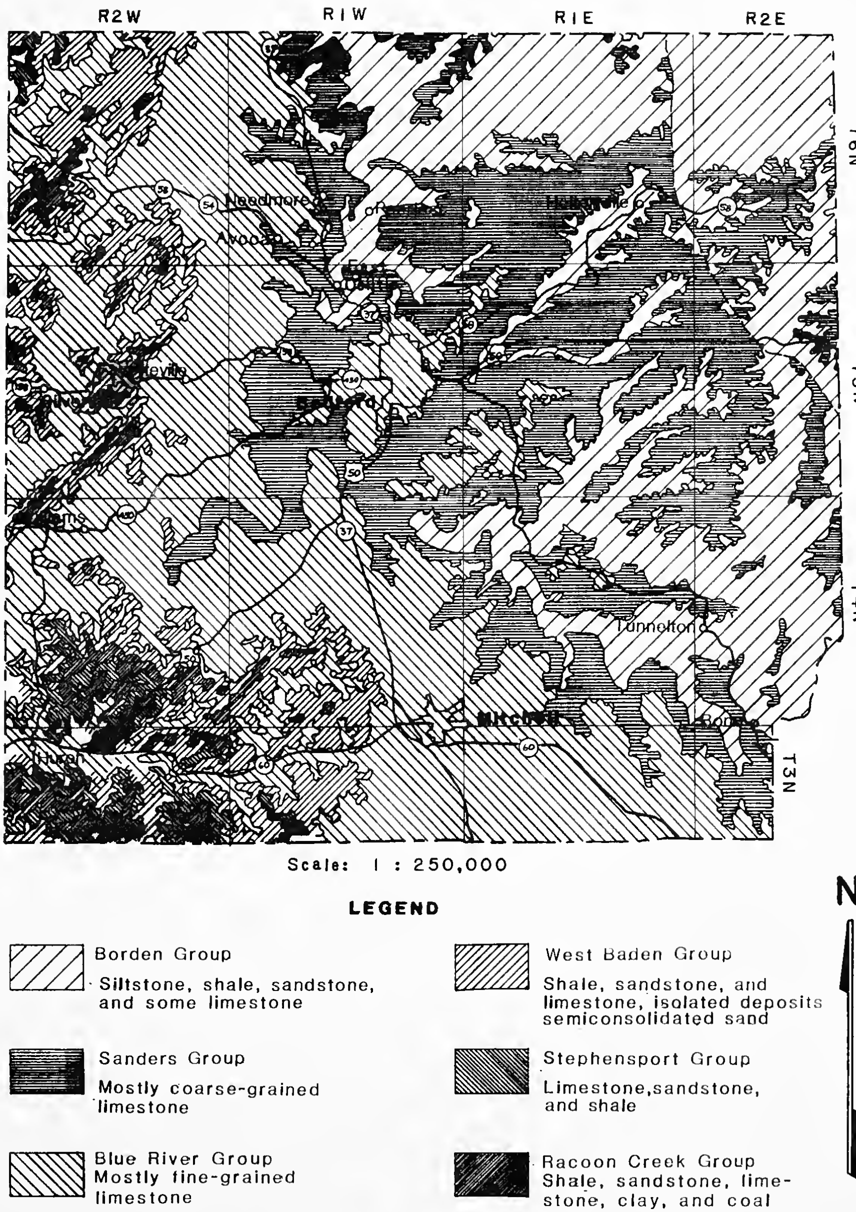


Figure 5. Bedrock Geology Map of Lawrence County. (After Reference (1))

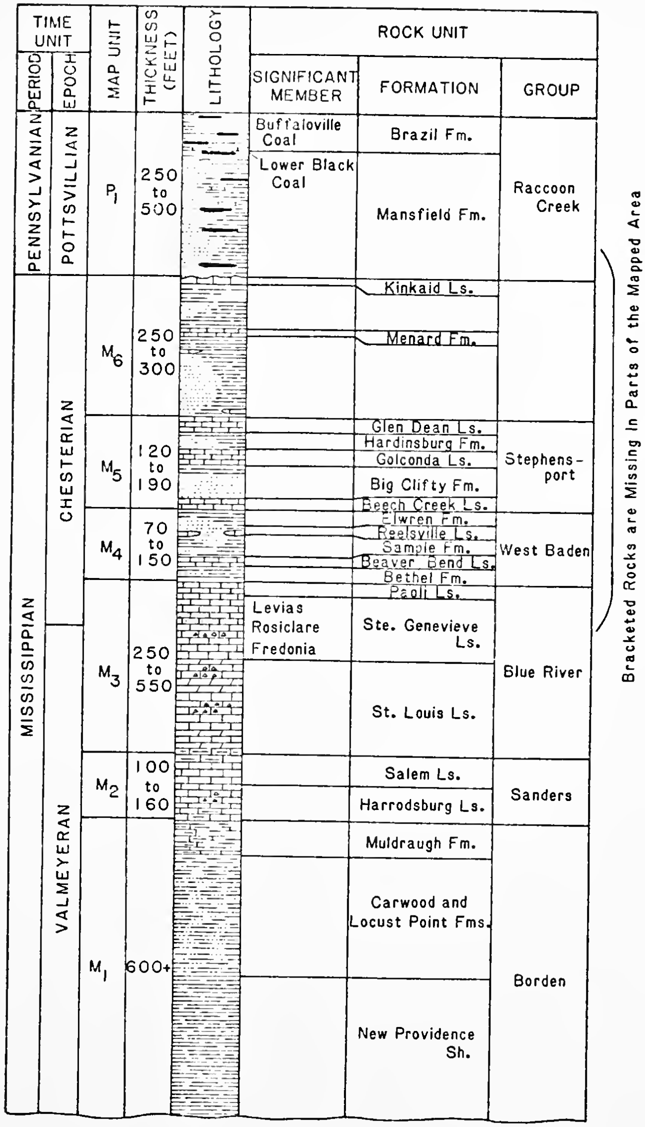


Figure 6. Columnar Section of Bedrock Units in Lawrence County. (After Reference (1))

ter Epoch and concluded by early Pottsvillian time (16). Subsequent Pennsylvanian deposition was influenced by regional structural irregularities resulting from the faulting (16). The fault is no longer active and presents no seismic hazard to the area.

The Mitchell Plain is composed of a series of limestone units of Mississippian Age. The oldest is the Sanders Group containing the Harrodsburg and Salem Formations. These limestones are coarse-grained, and do not have extensive karst features along their outcrop, as localized solutioning is not intense. The Harrodsburg Limestone is rather impure, containing large quantities of chert. The Salem Limestone is massive and relatively free of joints, and is quarried extensively as a building stone. It is less resistant to degradation than the underlying Harrodsburg, but is not easily distinguishable from it where exposed at the surface (13).

Finer-grained carbonate rock of the Blue River Group includes the St. Louis, Ste. Genevieve, and Paoli Limestones. They are characteristically thin-bedded and highly jointed, resulting in the development of classic karst topography along the outcrop. There are occasional thin layers of shale and impure limestone horizons. Chert is very conspicuous in the upper portion of the St. Louis Limestone. The Ste. Genevieve and Paoli Limestones are oolitic in nature, being composed of small sand-sized spheres of calcium carbonate called oolites. Karst development is most pronounced in the St. Louis Formation, and the outcrop forms a pock-marked plain with many sinkholes and

subterranean passages. The upper members of the Blue River Group also exhibit numerous sinkholes, and form low hills in the western third of the Mitchell Plain (13).

The bedrock of the Crawford Upland is complex and is composed of interbedded layers of sandstone, shale, and limestone. Rugged, angular topography results from extensive erosion of the weaker rocks, and bluffs are held up by the more resistant sandstones. The rocks of the Chester Series are of Mississippian Age. The oldest members are part of the West Baden Group and include the interbedded sandstones and shales of the Bethel, Sample, and Elwren Formations, and the Beaver Bend and Reelsville Limestones. The Stephensport Group includes the Beech Creek, Golconda, and Glen Dean Limestones, separated by the Big Clifty Sandstone and the sandstone and shale of the Hardinsburg Formation. Sandstones give rise to massive bluffs along many of the drainage divides. Limestones are of minor importance; although, solutioning is responsible for cavern and sinkhole development in some of the thicker members, especially the Beech Creek (13).

A large portion of Mississippian Age rock above the Stephensport Group is eroded. The Mansfield sandstone of the Raccoon Creek Group of Pennsylvanian Age lies unconformably on the Mississippian rock. It is massive, highly resistant, and frequently non-bedded. The formation is deposited on a very uneven surface and ranges in thickness from several feet (a few meters) up to 200 ft (61 m). Mansfield Sandstone is a major cliff former and is quarried in southwestern Lawrence County. In some areas, the

unit is composed of sandy shale and is much weaker. It is the youngest bedrock found in the county (13).

Pleistocene Geology

Although Lawrence County is unglaciated, the East Fork White River and Salt Creek valleys acted as major sluiceways carrying large volumes of glacial meltwater during Wisconsin time. As a result, large amounts of glacial debris are deposited in the deeply carved valleys. Some portions of the East Fork White River valley contain up to 150 ft (46 m) of unconsolidated material as can be inferred from the bedrock topography map of Lawrence County shown in Figure 7. The Salt Creek valley contains up to 80 ft (24 m) of glacial sediments near Oolitic, as seen in the profile of Figure 8, and upwards of 100 ft (30 m) near its confluence with the East Fork White River.

The unconsolidated deposits of Lawrence County are shown in Figure 9. The Prospect Formation is composed mostly of alluvium, with some colluvial and lacustrine deposits of Illinoian Age. It occurs in isolated patches throughout the area. Remnants of valley train deposits of late Illinoian and early Wisconsin Age are found along the East Fork White River, and are part of the Outwash Facies of the Atherton Formation. During periods of glacial melting, the large amounts of debris being carried along the major sluiceways blocked many of the side streams, resulting in the formation of shallow lakes or slackwater plains. Fine-grained sediments are deposited in these areas. Much of the

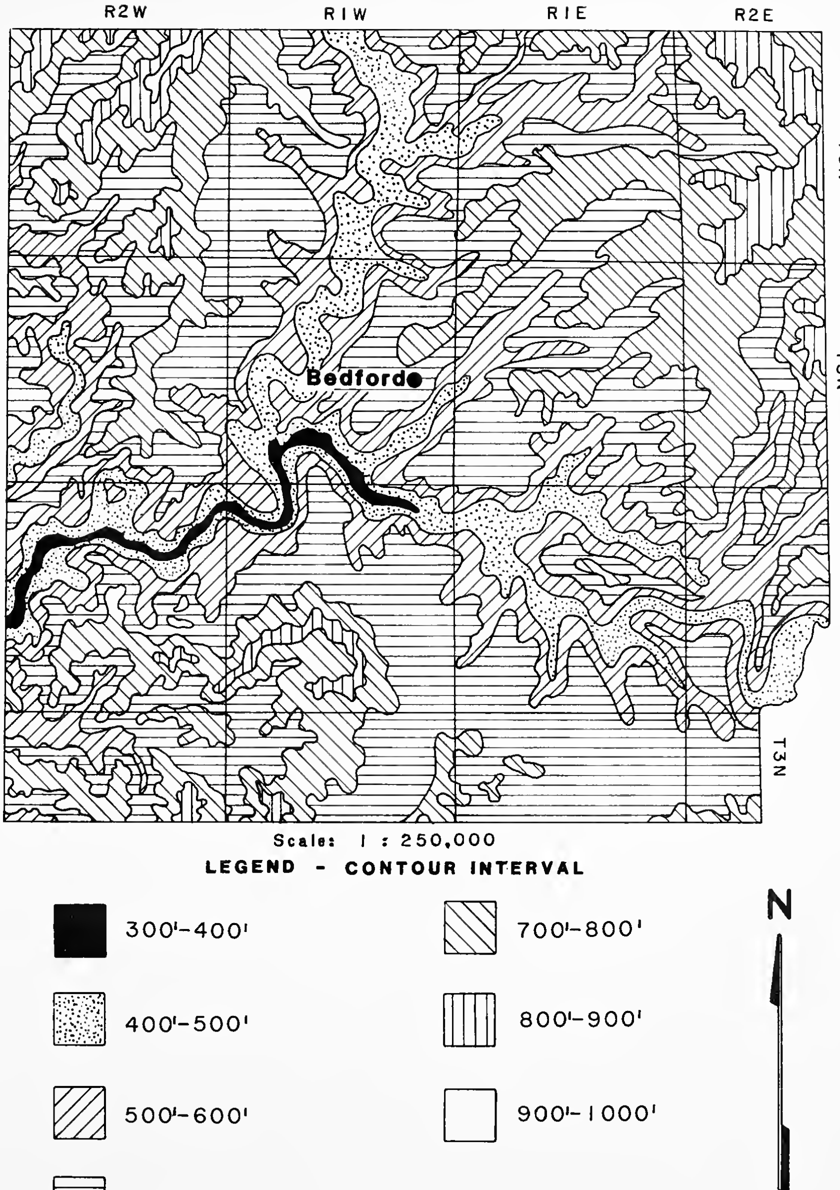


Figure 7. Bedrock Topography Map of Lawrence County. (After Reference (17))

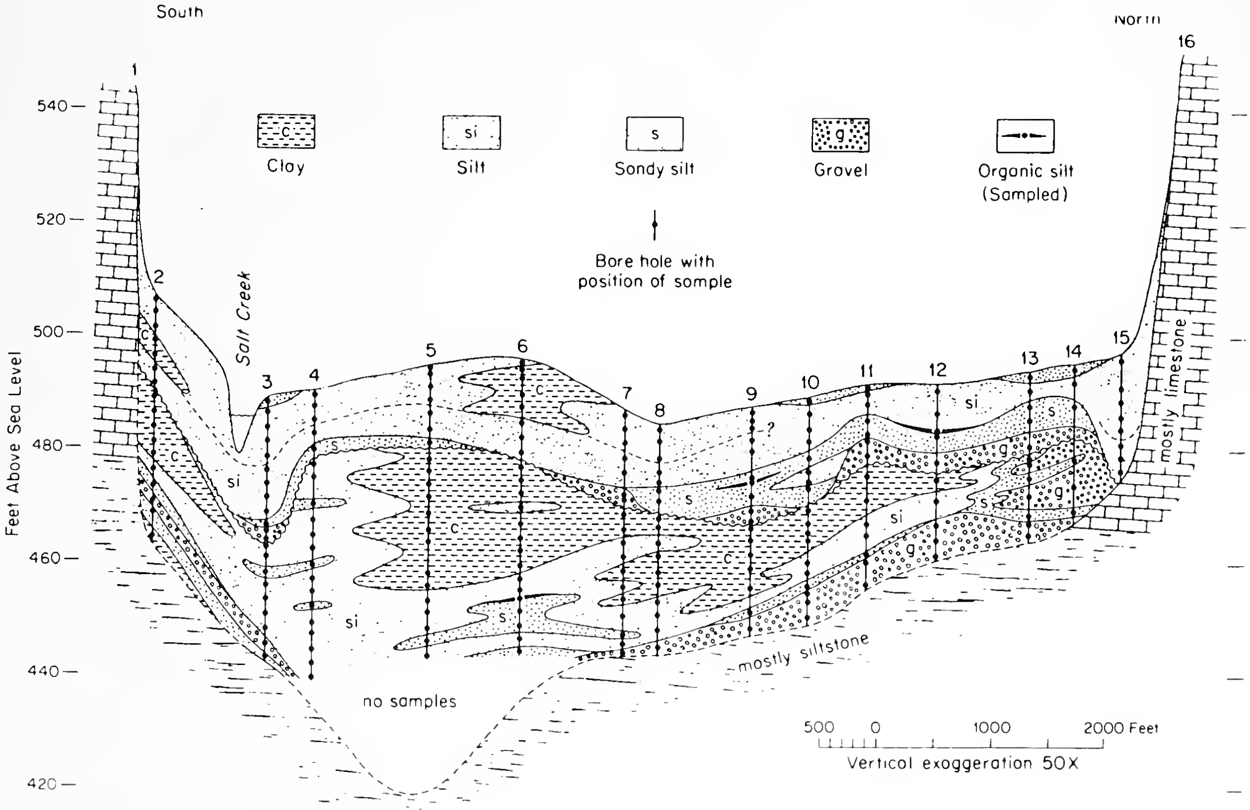
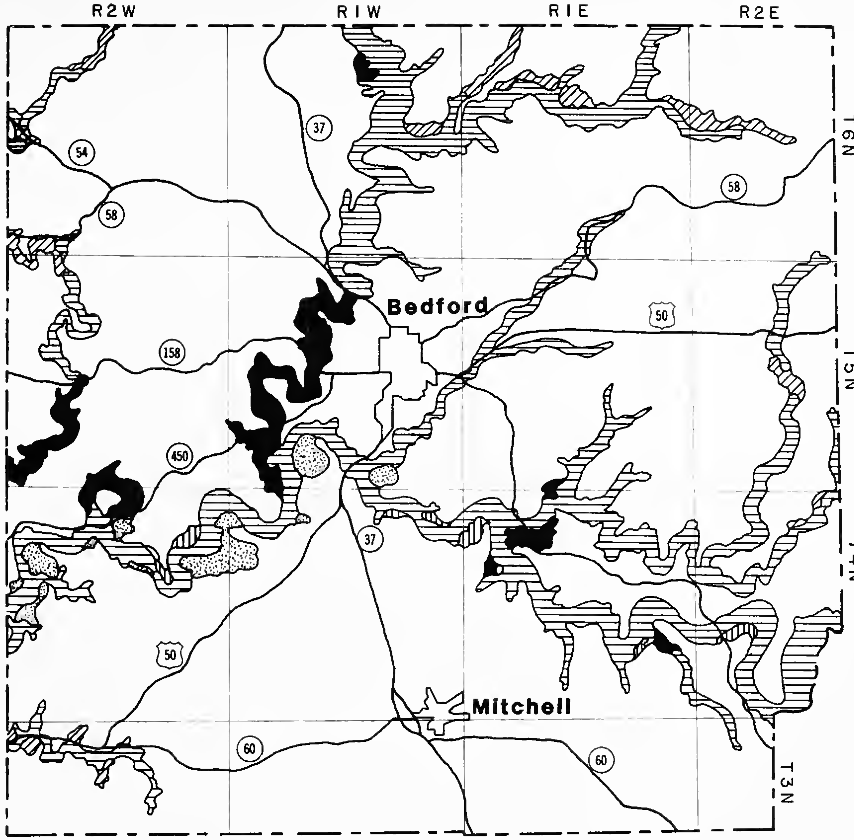


Figure 8. Cross-Section of Salt Creek Valley Along S.R. 37. (From Reference (18))



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LEGEND

Prospect Formation
Silt, sand, and gravel. Mostly alluvium, but includes some colluvial and lacustrine deposits

Dune facies of Atherton Formation Eolian sand and some silt

Outwash facies of Atherton Formation Gravel, silt, and sand Valley train deposits

Martinsville Formation
Silt, sand and gravel. Mostly alluvium, but includes some colluvial and paludal deposits

Lacustrine facies of Atherton Formation Clay, silt, and sand Lacustrine deposits

Residual soils

Figure 9. Unconsolidated Deposits of Lawrence County. (After Reference (1))

lower Salt Creek valley consists of lakebed deposits, which are very complex in nature (18). This is illustrated in Figure 8, which presents a cross-section of the valley as interpreted from a series of borings taken near Oolitic. These deposits represent the Lacustrine Facies of the Atherton Formation.

The coarse-grained sediments were subject to eolian action during late Wisconsin time. Sandy material formed dunes in the lower portion of the East Fork White River valley. Some of the dunes migrated onto the surrounding uplands. Finer-grained silt was also deposited on the uplands to form a thin layer of loess, but is not very significant. The sand occurs on terraces along the flood plain and is part of the Dune Facies of the Atherton Formation.

Other unconsolidated material is mostly alluvial in origin, but includes some colluvial and paludal deposits. These occur as silt, sand, and gravel deposits along the major streams in the county and are grouped into the Martinsville Formation.

Karst Morphology

The Mitchell Plain is the predominant landform in Lawrence County, covering almost half of the area. A unique topography, classified as "karst," is developed on much of the exposed limestone. The chemical and mechanical processes of weathering responsible for the development of karst features must be understood so that correct judgment is used when planning the design

and construction of engineering structures in such an area.

A highly developed karst topography contains numerous depressions, a notable lack of surface drainage, and many caves and subsurface openings. These features are formed by the solutioning of the mineral calcite ($CaCO_3$), the major constituent of limestone. Carbonic acid (H_2CO_3), formed when carbon dioxide (CO_2) dissolves in water (H_2O), reacts with calcite to form calcium bicarbonate, $Ca(HCO_3)_2$, which is thirty times more soluble in water than the original calcite. The reaction is represented by the chemical equations:

$$H_2O + CO_2 = H^+ + HCO_3^-$$

$$CaCO_3 + H_2CO_3 = Ca(HCO_3)_2$$

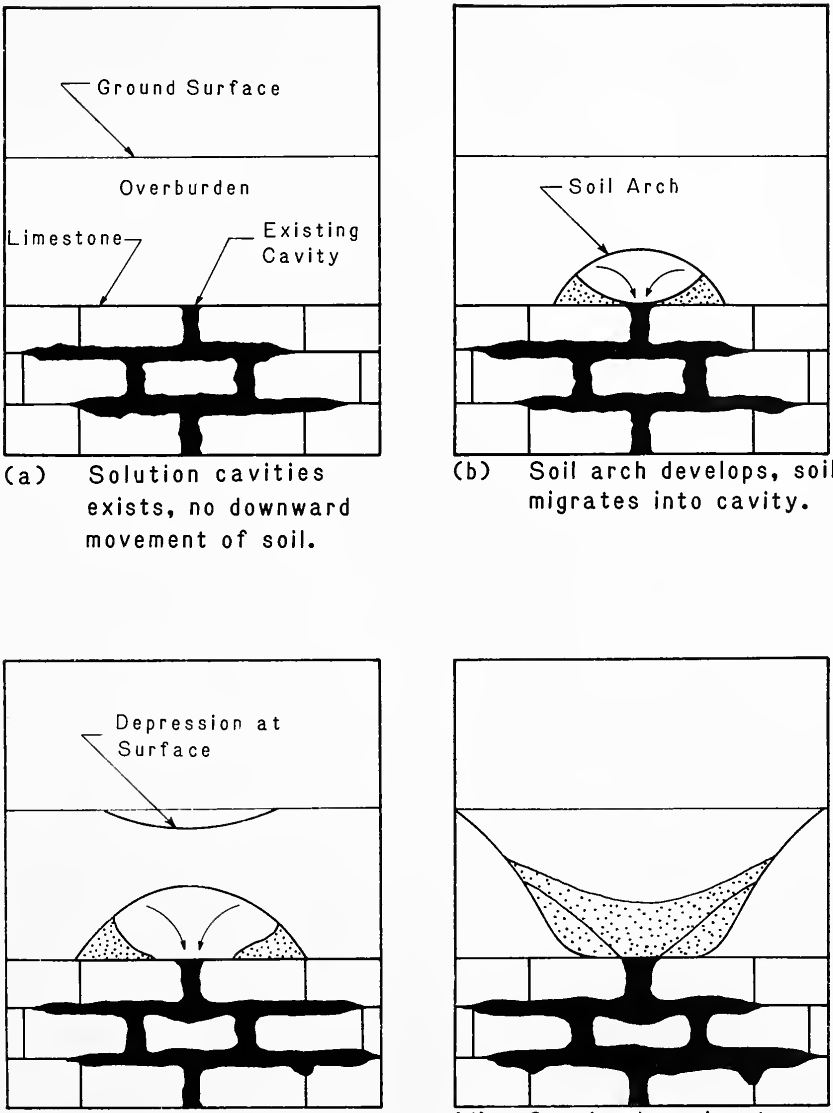
The calcium bicarbonate is carried away by flowing water. A similar reaction occurs with dolomite ($MgCa(CO_3)_2$; although, solutioning is not as intense as when the limestone is composed mostly of calcite (19).

Thornbury (20) cites four prerequisites for the development of karst topography: (a) the presence of a soluble rock at or near the surface; (b) a dense, highly fractured, thinly bedded rock; (c) entrenced major valleys within the upland; and (d) at least a moderate amount of rainfall. The Mitchell Plain satisfies these requirements since (a) limestones of the Sanders and Blue River Groups outcrop extensively; (b) the St. Louis and Ste. Geneveive Limestones are dense, highly jointed, and thinly bedded; (c) the East Fork White River, Salt Creek and other streams

have cut major valleys in the plain; and (d) the area receives an average of 45 in. of rainfall a year.

Solutioning is concentrated along the joints and bedding planes causing the development of large voids. Eventually, the cavity penetrates the overburden, creating an arch in the soil. A depression develops at the surface, and with time covers several acres (several hundred square meters) and reaches a depth of 50 ft (15 m) or more. This process is illustrated in Figure 10. Occassionally, the collapse is catastrophic rather than gradual (21).

Irregular weathering of the parent bedrock creates a very irregular soil-bedrock contact, which is evident along many of the exposed road cuts in Lawrence County. The clay residuum, which is a product of the limestone weathering, is highly plastic. Large rock fragments are often found in the lower soil profile, especially where collapse has occured. All of these factors result in the erratic nature of limestone residual soils and enhance the difficulty of solving engineering problems encountered in a karst area.



(a) Solution cavities exists, no downward movement of soil.

(b) Soil arch develops, soil migrates into cavity.

(c) Arch increases in size, subsidence evident at surface.

(d) Overburden migrates downward, dish-shaped depression at surface.

Figure 10. Process of Sinkhole Development.

Landforms and Engineering Soil Areas

The engineering soils in Lawrence County are derived both from unconsolidated material and from the weathering of sandstone, siltstone, shale, and limestone bedrock. The residual soils occur on the uplands as well as along the valley walls. Silty clays, silt loams, and clay loams are developed from the sandstones and shales of the Norman and Crawford Uplands. Silty clays and highly plastic clays are derived from the limestone bedrock of the Mitchell Plain. Thickness of the residuum is highly variable, especially in the limestone region. It ranges from bare rock exposure on some of the steep sideslopes up to about 35 ft (11 m) of soil on the flat uplands.

The unconsolidated materials include lacustrine, fluvial, glacio-fluvial, and eolian deposits. Fluvial deposits are confined to the valleys and lowlands. Rock-defended river terraces are common along the tributaries of the East Fork White River. Significant eolian activity in the form of incipient dune development is limited to the lower portion of the East Fork White River, although some small areas are found on the adjacent uplands. Thin loess deposits occur over most of the county, but are not significant in the development of the landforms and engineering soil units. Glacio-fluvial material is confined to the East Fork White River and Salt Creek valleys in the form of valley train remnants, most of which are reworked and almost indistinguishable from the more recent alluvium. Lacustrine sed-

iments are found in patches along the East Fork White River flood plain at the entrance to tributary valleys. A significant lake-bed deposit is found in the lower portion of Salt Creek valley.

The deposits of transported material are not homogeneous and large variation is expected. General soil profiles showing the textural characteristics that are expected for each engineering soil unit are presented on the map accompanying this report.

Fluvial Deposited Materials

Soils of fluvial origin in Lawrence County include alluvium deposited along the East Fork White River and its tributaries, and the sandy terraces adjacent to the river, which are subject to incipient dune development. These areas are symbolized with a sawtooth boundary on the accompanying soils map. The major streams are included for reference.

(1) Alluvium

(a) Flood Plain of the East Fork White River

Material encountered in the flood plain of the East Fork White River has distinguishing characteristics that warrant separation from alluvial soils of the tributary streams. A typical soil profile is more coarse-textured in the lower horizons than the alluvium deposited along side streams, since the velocity of the glacial meltwater was much higher than that of the present streams. Valley sediments are very deep, in some places approaching 150 ft (46 m). The flood plain averages about a half

mile (0.8 km) in width, but may be over a mile (1.6 km) wide in some sections.

The predominant pedological soils found in the flood plain of the East Fork White River include the Nolin, Newark, Petrolia, and Chagrin series. They occur on very shallow slopes of 0 to 3 percent. The upper horizon consists of 7 to 10 in. (18 to 25 cm) of loam (AASHTO Soil Classification A-4), silt loam (A-4, A-6) or silty clay loam (A-4, A-6, A-7). The subsoil extends to a depth of 3.5 to 10 ft (1 to 3 m) and is usually silt loam or silty clay loam. Occassionally, a loam (A-4) or sandy loam (A-2) is encountered. A third horizon of loam with some gravel (<10 percent) or stratified loam (A-4) and fine sand (A-2) may exist, especially where the intermediate zone is thin. Permeability ranges from poorly drained in the silty clay loam to well drained in the sandier deposits. No boring data is available in the flood plain of the East Fork White River.

Engineering problems associated with soils of the flood plain include high compressibility and low shear strength, making the unit generally unsuitable for building sites. In addition, the area is prone to frequent flooding. Bridge foundations present difficult challenges because of the deep deposits of soft materials. The flood plain is most suited to the development of recreational facilities and for cultivation.

(b) Flood Plains of the Tributary Streams of the East Fork White River

The alluvial soils formed along tributary streams of the East Fork White River are treated separately because they are not significantly influenced by glacial meltwater. The upper portion of Salt Creek valley contains soil of glacio-fluvial origin, but characteristics are similar to those of the other side streams. Mappable units of alluvium are located along Sugar, Fishing, and Mill Creeks in the southeast, Guthrie, Back, Crawford, and DeWitt Creeks in the northeast, Salt, Little Salt, Knob, and Henderson Creeks in the north, Popcorn and Indian Creeks, Armstrong and Spring Brooks in the northwest, and intermittant Beaver Creek in the southwest.

The pedological soils associated with this unit include the Haymond, Stendal, Wilbur, and Burnside series. Slopes are shallow (0 to 4 percent) along the bottomlands. Soils are somewhat uniform throughout the profile and vary between a loam (A-4) or silty clay (A-7) to a silt loam (A-4, A-6). A deposit of sandy loam (A-2) may be encountered at a depth of 20 to 45 in. (51 to 114 cm) in some sections. Bedrock is as shallow as 4 ft (1.2 m) in the Burnside soils formed in the upper portions of stream valleys, but in general, is at a much greater depth. The alluvial soils are derived from the residuum and loess of the surrounding uplands, and are, therefore, usually finer-grained than along the East Fork White River.

Borings 33 to 40 are located along S.R. 446 in the flood plain of Little Salt Creek in Sections 2, 9, and 14 of T6N, R1E. The boring data (22) reveals a weathered shale bedrock at a depth of 8 to 12 ft (2.4 to 3.7 m) along the outer portions of the valley away from the stream channel. Here, the soil is predominantly a silty clay (A-7) with shale fragments. The deposit increases in thickness toward the center where the surface soil changes to a silty clay loam (A-4, A-6, A-7). A subsoil of dense sandy loam (A-2) with gravel is encountered at a depth of 8 to 12 ft (2.4 to 3.7 m).

Borings 102 to 106 are located in a tributary valley of Beaver Creek in Section 33, T4N, R2W (23). The average subsurface profile consists of a stiff clay loam (A-7) with some fine sandstone gravel or clay pockets in the lower horizon. Sandstone bedrock is at a depth of 20 to 32 ft (6.1 to 9.8 m).

The soils of this unit are generally unsuited to building sites because of their high compressibility and low strength, as well as the high potential for flooding. Bedrock is not as deep as in the East Fork White River valley, so bridge design and construction is not as difficult. However, alluvial soils in the larger stream valleys, such as along Salt and Little Salt Creeks, may be as deep as 75 ft (23 m). Development in the flood plains should be restricted to cultivation and recreation.

(2) Sandy Terraces Along the East Fork White River

Several sandy terraces are developed in the coarser-grained soil along the lower portion of the East Fork White River. They are about 10 to 20 ft (3 to 6 m) above the flood plain. Eolian activity is responsible for incipient dune development on many of the terraces. The dunes are not in an active state of migration, as vegetation and finer-grained soils cover the coarser sand. The sandier regions are found primarily along the river valley in the western third of the county. A small terrace is found in Section 1, T4N, R1W, and several are located in Section 24, T4N, R1E and Sections 19 and 20, T4N, R2E. These are associated with valley train remnants and have larger amounts of gravel in the subsoil.

The principle pedological soils of this landform-parent material class are the Alvin, Abscota, Bloomfield, and Tyner series. All are well-drained, and are gently to moderately sloping. The Bloomfield and Alvin soils are found on ridge summits and sideslopes of terraces and are more likely to contain stratified sediments in the lower profile. The Tyner and Abscota soils are found on terraces above the river bottom and are generally sandier in texture, sometimes containing gravel in the lower sections.

The soil profile consists of fine sand (A-2), sand (A-2, A-3), loamy sand (A-2-4), or sandy loam (A-2, A-4) in the upper 5 to 18 in. (13 to 46 cm). The lower stratum is composed of loam

(A-4), sandy loam, loamy sand, and sand. Gravelly sand (A-1) may be found in the lower portion of the profile. Stratified sand and loamy sand is often encountered below this stratum at a depth of 3 ft (0.9 m) or more. No boring data are available for soils in this unit.

The main engineering problems encountered are extreme erosion potential, especially along the steep sideslopes; frequent flooding in the spring; and the high water table of the lower terraces. Building is generally restricted to the higher terraces. Recreational activities and limited farming are the primary land uses of the unit.

Bedrock-Defended Terrace Deposits

Small stream terraces are located in several of the valleys in Lawrence County. They are usually bedrock-defended, i.e. the underlying rock prevents excessive erosion and maintains the elevated position of the terrace above the flood plain. Several terraces are located along the angular course of Indian Creek. Here, the soils are of lacustrine origin, but they are grouped into the bedrock-defended river terrace unit because of the influence of the rock and the similarity of the soils to those of the adjacent stream valleys. Other terraces are found adjacent to Guthrie, Back, Popcorn, and Heatherwood Creeks. A large terrace is located at the junction of Pleasant Run and Salt Creeks, and a smaller one is mapped along the East Fork White River in Section 17, T4N, R1E. A highly dissected terrace is found along

Henderson Creek just east of its junction with Little Salt Creek. It is composed of alluvial and colluvial deposits of Illinoian Age. Other river terraces are found throughout the county, but are too small to map.

The agricultural soils found on these stream terraces include the Elkinsville Varient, Pekin, and Burnside series. The upper horizon consists of 0 to 17 in. (0 to 43 cm) of silt loam (A-4, A-6), loam (A-4), or silty clay (A-7). A second horizon extends to a depth of 40 to 55 in. (102 to 140 cm) and is composed primarily of silt loam and silty clay loam (A-4, A-6, A-7), along with lesser amounts of sandy loam (A-2, A-4) and loam. A 12 in. (30 cm) layer of loam or sandy loam is usually encountered below the silty clay loam and silt loam. The lower horizon is composed of stratified silty clay loam and sandy loam. Bedrock of either limestone or interbedded sandstone and shale is as shallow as 4 ft (1.2 m) close to the valley walls, but is generally much deeper. No borings are located on any of the mapped river terraces in the county.

Engineering problems encountered in the soils of these landforms are minimal. The lower terraces are subject to flood erosion and deposition. The dissected portions require some cut and fill for highway location. In general, the terraces are satisfactory for development where flood potential is small.

Lacustrine Deposited Materials

Many lacustrine deposits of Wisconsin Age are found along the tributaries of the East Fork White River. These are in the form of deep lakebed deposits such as in the Salt Creek valley, or as dissected terraces at the entrance to many of the tributary valleys. A dissected lacustrine terrace overlying limestone bedrock is located near the confluence of Salt Creek and the East Fork White River. No differentiation is made between lakebeds and lacustrine terraces on the map, but they are discussed separately in the following sections.

(1) Lakebed Deposits

Lakebed deposits are identified in several locations. The largest is along the lower portion of Salt Creek and in a horseshoe-shaped valley in Sections 3 and 4, T4N, R2W and Sections 34 and 35, T5N, R2W. These landforms generally have flat surfaces, but slopes become steeper and erosion more intense towards the valley walls due to sheet wash. A gradual transition from lakebed to terrace is observed in many locations along Salt Creek.

The pedological soils associated with lakebed deposits are the Bartle and Henshaw series, both of which exhibit shallow slopes. In general, they are relatively uniform in the upper portion of the profile, which is composed of silty clay loam (A-4, A-6, A-7) and silt loam (A-4, A-6). However, the deposits become very erratic with depth, as illustrated in the cross-

section of Salt Creek valley shown in Figure 8. Lenses and pockets of sand, silt, and clay, as well as thin seams of gravel, are interspersed throughout the profile.

(2) Lacustrine Terraces

Several dissected lacustrine terraces are identified in the county. In addition to those mapped as part of the lakebed of Salt Creek valley, examples are found at the entrances to the valleys of Guthrie and Sugar Creeks, and in a small valley in Section 18, T4N, R1E. A hummocky terrace overlying limestone bedrock is mapped separate from the lakebed deposit at the junction of Salt Creek and the East Fork White River.

Two pedologic soils, the Markland and McGary series, are associated with lacustrine and slackwater terraces. The McGary soil is found on shallow slopes of 0 to 6 percent, while the Markland is found in the more dissected areas, with slopes ranging from 2 to 70 percent. The upper horizon consists of 7 to 13 in. (18 to 33 cm) of silt loam (A-4, A-6) and silty clay loam (A-4, A-6, A-7). An intermediate horizon of silty clay (A-7) extends to a depth of 28 to 39 in. (71 to 99 cm). The lower horizon is composed of stratified silty clay and clay (A-7).

Borings 65 to 67 are located along S.R. 37 in Salt Creek valley north of Bedford (24). The subsurface profiles of borings 65 and 66, both located close to Salt Creek, reveal at least 50 ft (15 m) of silty clay loam, silt, and loam, all classified as

A-4 material. Clay and sand seams are present throughout the profile. Boring 67 is located closer to the valley wall, and the subsurface is much more erratic. The top 13.5 ft (4.1 m) consists of silty clay loam (A-4), followed by 4 ft (1.2 m) of sandy loam and loam with sand seams (A-4). A clay deposit (A-7-6) with lenses of silt extends to a depth of 41.5 ft (12.6 m), where a dense sandy loam with gravel (A-1-b) is encountered.

Borings 68 to 72 are located along S.R. 37 in lacustrine material deposited in the valley of Goose Creek (24). This valley is narrow and is obscured on the soils map by S.R. 37. The profile consists of 1.0 to 4.0 ft (0.3 to 1.2 m) of silty clay loam (A-4), 4.0 to 10.5 ft (1.2 to 3.2 m) of silty clay loam (A-6), and variable layers of loam (A-4) with sand seams, sandy loam (A-4), silty clay (A-7-6), and clay (A-7-6). A lower stratum of medium dense sandy loam (A-1-b) is encountered at progressively shallower depths of 35.0 ft (10.7 m) in boring 68 to 23.0 ft (7.0 m) in boring 72.

Borings 91, 92, 92A, 93, and 94 are located along the new portion of S. R. 450 in Section 29, T5N, R1W (25). The subsurface profile in this area is very erratic, with layers of silty clay (A-7), silty clay loam (A-4, A-6, A-7) and clay (A-6, A-7) of various thicknesses interbedded throughout. Lenses of fine sand and silt are also found in Boring 92A below a depth of 23.5 ft (7.2 m).

The major engineering problems encountered in lacustrine

sediments are a result of the soft, moist nature of the deposits. Building is a problem because the soils are highly compressible and have a low shear strength. The soft clays and silts make poor subgrade materials. Highway embankments induce large settlements. Bridge construction is difficult because of the depth to bedrock, especially in Salt Creek valley. Flooding is also a problem in the low-lying areas. This landform-parent material class is best suited to farming and recreational activities.

Eolian Deposited Materials

Windblown sands and silts are found on many of the uplands adjacent to the East Fork White River. Intermittant dune development occurs on the sandy terraces of the flood plain of the river as already discussed. The eolian deposits found on the upland are derived from the sandy material of the alluvial plain. Eolian forces carry the sand and silt from the valley and deposit them on the uplands in the form of low dunes. Active dune development is minimal at present. The eolian drift is underlain by, and in some cases intermixed with, the residuum of the limestone and interbedded sandstone and shale bedrock.

Most of these deposits are found in the western half of the county. Old dissected valley train deposits reworked by the wind are mapped as eolian drift over bedrock. One of these old terraces is identified in Sections 6 and 7, T4N, R1E, and Section 24, T4N, R1E, and another in Sections 23, 26, and 30, T4N, R1E. A small bedrock outlier covered by eolian drift is found in Sec-

tions 23 and 26, T4N, R1E.

The agricultural soils associated with this landform-parent material class are the Princeton and Martinsville series. Princeton soils develop on the uplands in the sandy and silty eolian drift. A typical subsurface profile consists of 11 in. (28 cm) of loam (A-4) and sandy loam (A-2, A-4), 15 in. (38 cm) of sandy clay loam (A-4, A-6), and 34 in. (86 cm) of sandy loam (A-2, A-4) and loamy fine sand (A-2-4). The substratum is composed of stratified loamy fine sand and fine sand (A-2-4). Martinsville soils occur mainly on the benches elevated above the adjacent alluvial plain. They are derived from old river deposited materials which are reworked by the wind. The upper 12 in. (30 cm) consists of loam (A-4), silt loam (A-4, A-6), and sandy loam (A-2, A-4). The subsoil is composed of 11 in. (28 cm) of silty clay loam (A-4, A-6, A-7), 7 in. (18 cm) of clay loam (A-6, A-7), and another 11 in. (28 cm) of sandy loam. The substratum contains stratified sandy loam, sand (A-2-4, A-3), sandy clay (A-4, A-6), and silt (A-4). Bedrock of limestone or interbedded sandstone and shale is encountered as shallow as 5 ft (1.5 m), but is generally at a much greater depth. Boring data is unavailable for these eolian deposited materials.

Engineering problems associated with soils of this unit are primarily associated with cut and fill for transportation routes. The silty materials are difficult to compact and slope erosion is common. The soil profile is highly erratic, as the relative compostition and presence of the eolian soils, residuum, and bedrock

varies considerably from point to point.

Residual Soils

Residual soils derived from the limestone, siltstone, sandstone, and shale bedrock constitute the largest landform-parent material class in Lawrence County. Soils of limestone origin are found throughout the Mitchell Plain and extend into the karst valleys of the Crawford Upland and are found on the uplands of the Norman Upland. Shaly and sandy residuum is found on the highly eroded slopes of the Norman Upland and on the hills and ridges of the Crawford Upland. Each type is discussed separately in the following sections.

(1) Residuum Developed in Sandstone-Shale and Sandstone-Shale Over Limestone

Residual soils derived from interbedded sandstone-shale bedrock occupies about 38 percent of the county. The complexity and variability of the subsurface profile require that the unit be divided into three parts: soils found on the sandstone-shale uplands; those formed on the steeper sideslopes; and those associated with interbedded sandstone-shale-limestone parent bedrock. Depth to rock, soil texture, and erosion charcteristics are different for each type.

(a) Sandstone-Shale Uplands

Shallow soils derived from clastic parent rock are developed on the ridges and flat uplands of the highly dissected sandstone-shale plain. A loess veneer less than 15 in. (38 cm) thick covers the residuum throughout the unit. The agricultural soils formed in these areas include the Ebal, Gilpin, Hosmer, and Wellston series. Ebal and Hosmer soils are formed on the flatter portions of the upland, with slopes ranging from 0 to 30 percent. The residuum is 5 ft (1.5 m) or more in thickness. A topsoil of silty loam (A-4) 8 to 10 in. (20 to 25 cm) thick overlies 13 to 19 in. (33 to 48 cm) of silty clay loam (A-4, A-6, A-7), silt loam, or silty clay (A-7). The substratum is composed of either clay (A-7) or a silt loam fragipan to bedrock. Gilpin and Wellston soils are found on the upper portions of the valley sideslopes (0 to 70 percent). The soil mantle is much thinner and contains a higher percentage of rock fragments than the Ebal and Hosmer series. Gilpin soils are composed of shaly to very shaly silt loam containing up to 35 percent rock fragments greater than 3 in. (7.6 cm) size, and are classified as A-1, A-2, A-4, or A-6. Wellston soils show about 25 in. (64 cm) of silt loam (A-4) or silty clay loam (A-4, A-6, A-7), underlain by shaly to very shaly loam to a depth of 45 in. (114 cm), where bedrock is encountered.

(b) Sandstone-Shale Sideslopes

The soils developed on the steeper portions of the valley

sideslopes are generally shallower and contain more rock fragments than those of the adjacent uplands. They are especially predominant in the northeastern part of the county where interbedded siltstones and shales are severely eroded. They are also found on the steep-sloping hills of the southern portion of the Crawford Upland, and are encountered less frequently in the other sandstone-shale areas.

The predominant agricultural soils include the Berks, Gilpin, and Weikert series, formed on slopes of up to 80 percent. Large fragments of shale, siltstone, and sandstone are found throughout the profile. Rock outcrops are common. Where the residuum is developed, the upper horizon consists of 8 to 10 in. (20 to 25 cm) of silt loam (A-4) or channery (stony) silt loam (A-2, A-4). The subsoil consists of very channery silt loam and loam (A-1, A-2, A-4). Rock fragments greater than 3 in. (7.6 cm) in size comprise up to 40 percent of the soil. Bedrock is at a depth of 18 to 33 in. (46 to 84 cm).

(c) <u>Sandstone-Shale Over Limestone</u>

In many areas throughout the Crawford Upland, a complex geology of interbedded sandstone, shale, and limestone produces a slightly different residual soil cover than that which is found where the parent material is predominantly sandstone-shale. This occurs along the lower slopes where the interbedded sandstones, shales, and limestones of the West Baden Group overlie the thicker limestone sediments of the Blue River Group. The soils

developed in the vicinity of this contact tend to be more clayey in the lower part of the profile. The upper layer is composed of 0 to 15 in. (0 to 38 cm) of silt loam (A-4, A-6) and shaly silt loam (A-2, A-4, A-6). The subsoil contains silt loam and silty clay (A-6, A-7) to a depth of 3 ft (0.9 m). A third horizon consists of loam (A-4) and clay (A-7) to a depth of 5 ft (1.5 m). A 12 in. (30 cm) layer of sandy loam with gravel (A-2, A-4) and loam with gravel (A-4) often overlies the sandstone-shale bedrock. In general, the depth to sandstone-shale bedrock is 0 to 6 ft (0 to 1.8 m), while limestone is found at a depth of 4 to 9 ft (1.2 to 2.7 m).

Borings 99 to 101, and 107 to 113 are located along a new relocation route for U.S. 50 in the southwestern part of the county (23). The route is through very rugged terrain, and depth to bedrock is highly variable. Composition of the residuum is complex, with textures ranging from clay and clay loam (A-7-6), silty clay loam (A-6), sandy clay and sandy clay loam (A-6), to silt loam (A-4). Parent rock of interbedded sandstone, shale, and limestone is at a depth of 2 to 12 ft (0.6 to 3.7 m), with the shallower soils located on the ridge tops and sideslopes and the deeper soils found on the broader valley bottoms. Rock fragments are encountered throughout the soil profile. Boring 107 is typical of a ridgetop deposit, with 5.2 ft (1.6 m) of silty clay loam (A-6) overlying 39.1 ft (11.9 m) of fine to coarse-grained sandstone. Below this is 15.8 ft (4.8 m) of interbedded sandy shales and shaly sandstones, followed by laminated soft shales to

a depth of 75.4 ft (23.0 m), where the boring was terminated. Locations 108, 109, and 110, typical of the deeper soils of the narrow valley bottoms, reveal 6 ft (1.8 m) of sandy clay (A-6), 1.5 ft (0.5 m) of silty clay loam (A-7-6), followed by 5.2 ft (1.6 m) of clay loam (A-7-6).

Borings 20, 21, 27, 28, 30, 32, 41, 43, and 44 are located along S.R. 450 in the northeastern part of the county (22). Soils are predominantly silty clays (A-6, A-7-6) and clays (A-7-6). Location 27 and 28 are typical of this part of the Norman Upland. They both contain 5 ft (1.5 m) of silty clay (A-6) in the upper horizon, but in #27, this is underlain by 7 ft (2.1 m) of silty clay (A-7-6), while #28, the lower zone is composed of sandstone bedrock. Boring 30 reveals 7 ft (2.1 m) of shaly silt loam (A-2, A-4) above a hard shale. Boring 44 contains 9.3 ft (2.8 m) of sandy clay with gravel (A-7-6), followed by 10 ft (3.0 m) of limestone, which is underlain by hard shale.

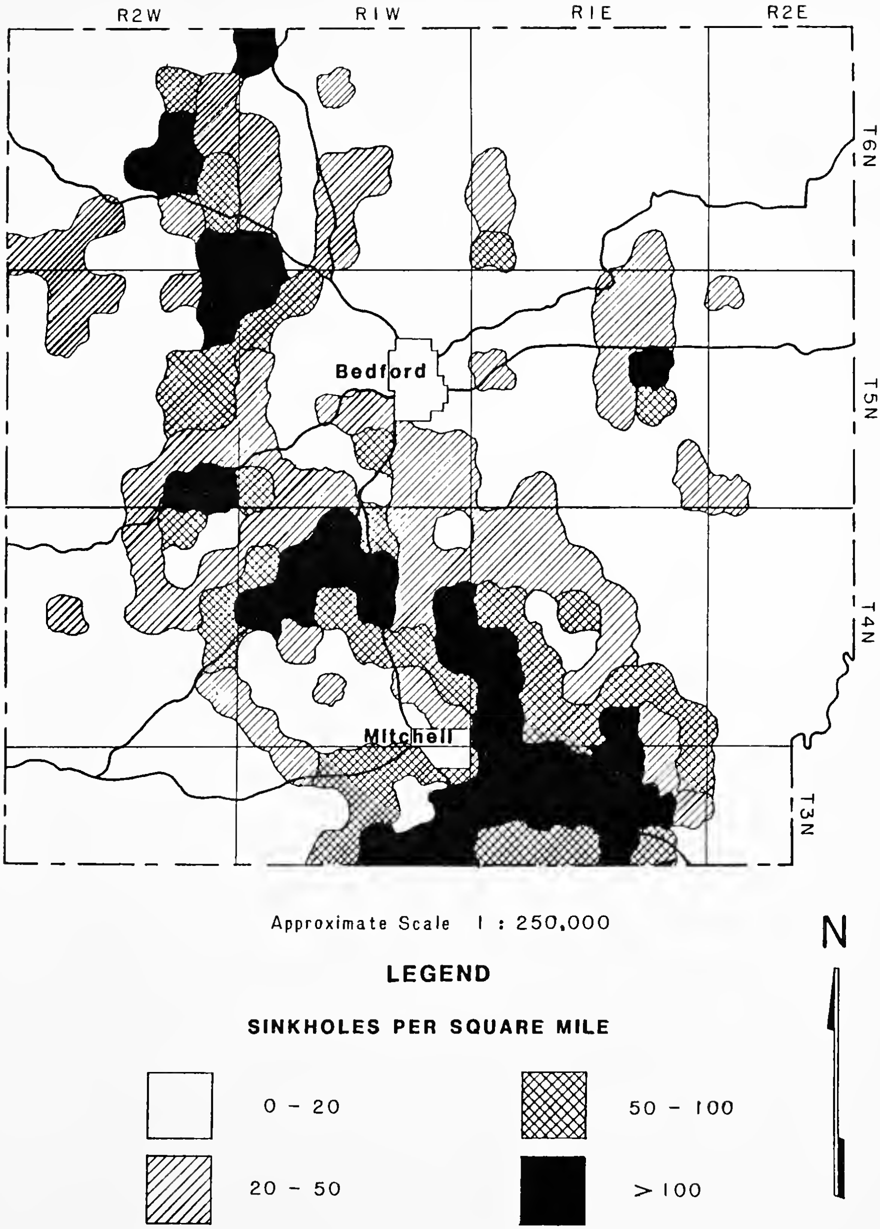
Many engineering problems are encountered in the interbedded sandstone, shale, and limestone areas. The rugged topography, complexity of the geology, and variable depth to bedrock present serious problems when planning cut and fill requirements for transportation routes. The shaly soils present a unique challenge when used as fill in an embankment. Difficulty in compaction and slaking of the shale fragments are but two problems which require special procedures when using shale as a construction material. Slope instability is common along highway cuts. Solution features such as underground caverns and sinkholes

develop where limestone is close to or at the surface. Drainage is a problem in the clayey soils. The inaccessibility of the areas require that development be restricted to the broader drainage divides and ridgetops.

(2) Residuum Developed on Limestone

Residual soils of limestone origin cover about 48 percent of the county. They are developed on the broad limestone plain of the Mitchell Plain physiographic subsection, but are also found on the flat uplands of the western part of the Norman Upland as well as the karst valleys of the Crawford Upland. The entire unit exhibits classic karst topography, especially in the western half. Solution features, which include sinkholes, caverns, and subterranean cutoffs, are very common.

Sinkhole development is intensive where the St. Louis and Ste. Geneveive Limestones are exposed at the surface. The density of sinkholes ranges from less than 20 up to almost 1000 per square mile (2.56 sq. km) near Mitchell. A sinkhole density map has been prepared for Lawrence County, and is shown in Figure 11. It was prepared from the drainage map of Figure 3 by simply counting the number of sinkholes in each land survey section. A wide band of dense sinkhole development (>20 per sq. mile) is seen in the southern part of the county, but becomes narrower and more irregular north of the East Fork White River. This roughly correlates with the outcrop of the St. Louis, Ste. Geneveive, and Poali Limestones of the Blue River Group.



Approximate Scale 1 : 250,000

Figure 11. Sinkhole Density Map of Lawrence County.

The predominant textures of the limestone residual soils are clay and silty clay. However, as with the sandstone-shale areas, soils developed on the flat uplands differ from those formed on the steeper sideslopes, and will be discussed separately.

(a) Limestone Uplands

Soils developed on the flat to gently sloping areas of the Mitchell Plain are moderately deep, somewhat silty in the upper horizon, and moderately well-drained. A thin layer of loess (silt loam) blankets the area, and has a thickness of about 1 to 3 ft (0.3 to 0.9 m). Surface streams are generally not well-developed, and swallow-hole type drainage is very common. Sink-holes dot the surface, especially in the western half of the plain. The steeper slopes are highly dissected. Some large streams cut into the plain and produce narrow, steep-sided, gorge-like valleys. It is on the broad drainage divides between these valleys that the deep residuum develops.

The predominant agricultural soils found on the uplands are the Bedford, Crider, and Frederick series, and to a lesser extent, the Hoosierville and Muren series. Bedford and Crider soils develop on the rolling uplands and the upper parts of sin-kholes, are generally more clayey in the lower horizon, and exhi-bit slopes of 0 to 30 percent. Hoosierville and Muren soils are formed on the broad drainage divides where the loess cover is thickest, and are, therefore, very silty throughout the profile. They exhibit shallow slopes of 0 to 12 percent. Frederick soils

are generally found in the lower portion of sinkholes and on the steeper sideslopes (0 to 60 percent), and are generally composed of clay below 12 in. (30 cm).

The generalized soil profile is composed of 9 to 38 in. (23 to 97 cm) of silt loam (A-4, A-6), underlain by 4 to 25 in. (10 to 64 cm) of either clay loam (A-6, A-7) or silty clay loam (A-4, A-6, A-7). This lower horizon extends to a depth of up to 50 in. (127 cm). The third zone is composed of varying amounts of clay (A-7), silt loam, and silty clay. Limestone bedrock is encountered at a depth of 60 in. (152 cm) or more.

(b) <u>Limestone Sideslopes</u>

The residual soils formed along the valley walls and steep sideslopes have a much thinner mantle and more variable depth to bedrock than those developed on the uplands. Loess thickness is also thinner, and the surface is much more dissected due to intense gulley erosion. The Caneyville and Frederick agricultural soils are found in these areas on slopes of 2 to 75 percent. The upper horizon is composed of 5 to 13 in. (13 to 33 cm) of silt loam (A-4, A-6), underlain by a 15 in. (38 cm) layer of silty clay (A-7), and a zone of clay (A-7). In some cases, the silty clay horizon is absent. Depth to bedrock is usually between 12 and 72 in. (30 and 183 cm).

Borings 1 to 7 are located along S.R. 158 in a karst valley of the Crawford Upland (26). The upper horizons are primarily

clay and clay loam (A-6), and to a lesser extent, silty clay (A-6). Boring 3 is typical of the area, with 3.0 ft (0.9 m) of clay, 5.0 ft (1.5 m) of silty clay, and 6.0 ft (1.8 m) of clay (A-6) overlying a weathered limestone. Locations 4 and 5 reveal 7 ft (2.1 m) of clay loam (A-6), 5.5 ft (1.7 m) of sandy loam (A-2-4), 2.0 ft (0.6 m) of clay (A-6), underlain by 6.0 ft (1.8 m) of sandy loam with rock fragments, over limestone. Boring 6 contains 7.5 ft (2.3 m) of clay loam with limestone fragments over a weathered limestone bedrock.

Borings 12 to 20, 22, 23, 25, 26, and 29 are located along S.R. 446 on a limestone upland within the Norman Upland (22). Data from the borings reveal clay (A-7-5, A-7-6), silty clay (A-6, A-7-6), and silty clay loam (A-6) throughout the soil profile. Location 13 is typical and is composed of 5.5 ft (1.7 m) of clay (A-7-6), 2.5 ft (0.8 m) of silty clay (A-6), another 3.5 ft (1.1 m) of clay, underlain by a hard limestone. Boring 17 represents a small stream valley, and the profile consists of 2.5 ft (0.8 m) of sandy loam with gravel (A-2-6) over limestone. Locations 22 and 23 are on a flat divide and contain 4.5 ft (1.4 m) of clay (A-7-5) and 4 ft (1.2 m) of silty clay (A-7-6), respectively, over hard limestone. Boring 29 is composed of 7.5 ft (2.3 m) of clay (A-7-5) and 2.8 ft (0.9 m) of sandy clay (A-4), underlain by limestone bedrock.

Location 114 is the site of a new bridge over Spring Creek along S.R. 54 near the junction with S. R. 58 (27). Five borings taken in the residuum reveal silt loam with traces of limestone

fragments (A-4) and silty clay loam (A-4), underlain by limestone bedrock at a depth of 3.8 to 4.3 ft (1.2 to 1.3 m).

Borings 45 to 64, 73 to 80, 80A, 80B, 81 to 90, and 8 to 11 are located along S.R. 37 from the East Fork White River north to the Monroe County line (24, 28, 29). They provide an excellent north-south cross section of the Mitchell Plain in this vicinity. Since the boring data is so numerous, it is impossible to discuss each, but a generalized profile is constructed. The typical boring contains 0.3 to 2.0 ft (0.1 to 0.6 m) of silty clay loam topsoil (A-6), 2.5 to 8.5 ft (0.8 to 2.6 m) of silty clay (A-6) and silty clay loam (A-4, A-6, A-7-6), and anywhere from 1.0 to 30.0 ft (0.3 to 9.1 m) of clay (A-7-5, A-7-6). The lower portion of the residuum usually contains gravel and angular rock fragments. Occassionally, this third horizon consists of clay loam (A-6) or silty clay loam (A-4), but this is the exception. In some of the borings, a layer of loam with gravel, weathered shale, or chert bed exists. Limestone bedrock is encountered at a depth ranging from 2.0 to 34.0 ft (0.6 to 10.4 m) below the surface.

The variable depth to bedrock is illustrated by the data presented in Table 2, which lists the boring number, station number, depth to bedrock (or refusal), elevation to the top of rock, and topographic landform where the boring was taken. After careful study, it is very difficult to correlate depth to bedrock with landform. In general, depth to rock is greatest on the high ground (described as hilltops) surrounding the many depressions. However, the data indicate that it is on these landforms where

Table 2. Depth to Limestone Bedrock for Selected Borings Along S.R. 37.

BORING NO.	STATION NO.	DEPTH TO ROCK ft (m)	ELEV. TO TOP OF ROCK ft(m)	TOPOGRAPHIC LANDFORM
45	242+27**	4.0 (1.22)	557.1(169.8)	Steep Sideslope
48	53+50	7.2 (2.19)	615.7(187.7)	Flat Upland
51	73+00	23.5 (7.16)	638.5(194.6)	Hilltop
53	83+00	15.5 (4.72)*	649.8(198.1)	Hilltop
55	91+35	17.7 (5.39)	584.5(178.2)	Sinkhole
56	97+30	11.0 (3.35)	621.3(189.4)	Hilltop
57	143+00	33.0(10.06)	645.0(196.6)	Hilltop
59	150+50	34.0(10.36)*	654.0(199.3)	Hilltop
60	156+50	22.0 (6.71)*	655.3(199.7)	Hilltop
61	164+85	8.0 (2.43)*	651.3(198.5)	Hilltop
62	203+25	5.5 (1.68)*	618.2(188.4)	Sinkhole
63	206+37	21.7 (6.61)*	612.2(186.6)	Rim of Sinkhole
64	217+00	8.0 (2.44)	580.9(177.1)	Flat Upland
73	310+00	18.3 (5.58)*	474.8(144.7)	Shallow Sideslope
75	314+00	28.0 (8.53)*	467.5(142.5)	Shallow Depress.
76	318+00	21.0 (6.40)*	476.1(145.1)	Shallow Sideslope
77	330+00	2.0 (0.61)*	537.1(163.7)	Hilltop
79	375+00	13.0 (3.96)	590.3(179.9)	Flat Upland
80	380+00	22.0 (6.71)	589.2(179.6)	Flat Upland
80A	394+00	23.0 (7.01)	634.0(193.2)	Hilltop
80B	402+00	27.0 (8.23)	655.0(199.6)	Hilltop
81	421+50	20.0 (6.10)	682.0(207.9)	Hilltop
82	430+50	15.0 (4.57)	633.7(193.2)	Gulley
83	435+50	14.0 (4.27)*	673.2(205.2)	Hilltop
84	443+75	19.0 (5.79)	636.0(193.9)	Lowland
85	482+00	16.0 (4.88)	667.7(203.5)	Shallow Sideslope
87	497+00	25.0 (7.62)	655.1(199.7)	Hilltop
11	683+95	6.0 (1.83)	618.0(188.4)	Hilltop

*Refusal　　**Ramp NWL　　(Compiled from References 23, 27, 28)

the variability is greatest (2 to 34 ft (0.6 to 10.4 m)). The soil mantle is thinnest on the sideslopes. As discussed previously, solutioning along joints and bedding planes produces the highly irregular bedrock surface. Rock pinnacles or deep clay-filled solution-enlarged joints are encountered anywhere in the limestone plain. Therefore, general conclusions drawn from the data are to be used with caution. Site specific borings are required.

Boring 57 is typical of the subsurface profile found on a hilltop, although the clay layer above the bedrock is somewhat deeper than average (24). A silty clay loam topsoil (A-6) 0.5 ft (0.2 m) thick overlies 2.5 ft (0.8 m) of silty clay loam (A-4), 17 ft (5.2 m) of stiff clay (A-7-6), 8 ft (2.4 m) of stiff clay with rock fragments (A-7-6), and 5 ft (1.5 m) of soft to medium stiff clay (A-7-6). Fine-grained thin-bedded limestone is at 33 ft (10.1 m). A 0.6 ft (0.2 m) thick bed of laminated shale is encountered at a depth of 36.8 ft (11.2 m).

Boring 55 is located in a sinkhole and reveals 0.5 ft (0.2 m) of silt loam topsoil (A-7-6), 6.5 ft (2.0 m) of silty clay loam (A-4), 3.0 ft (0.9 m) of clay with rock fragments (A-6), 5.0 ft (1.5 m) of stiff clay (A-7-6), and then another 2.7 ft (0.8 m) of clay with limestone fragments (A-6). Refusal was met at 17.7 ft (5.4 m) (24).

Boring 45 is typical of the soil profile of a steep sideslope where depth to bedrock is shallow (24). The subsurface

contains 0.5 ft (0.2 m) of gravel and boulders, 2.0 ft (0.6 m) of clay with rock fragments (A-7-6), 1.5 ft (0.5 m) of hard shale with limestone fragments, underlain by medium-grained limestone with some thin clay layers.

Voids were encountered in two of the borings (28). Location 80 revealed a 2.5 ft (0.8 m) thick void filled with a fat clay, 1.2 ft (0.4 m) within the limestone and 23.2 ft (7.1 m) below the surface. Boring 84 reveals a 0.8 ft (0.22 m) thick water-filled void beneath 1.0 ft (0.3 m) of limestone and 19.0 ft (5.8 m) of soil.

Serious engineering problems are encountered in limestone areas. Irregular weathering of the bedrock surface presents difficulties when large excavations or deep foundations are required. Planning of cut and fill operations for transportation routes is very difficult. The highly plastic clay residuum is not a poor engineering material in its natural state, since it generally has relatively high permeability for a clay because of the internal structure of the particles. However, reworking the material destroys the fabric and decreases the permeability. Pavement pumping and poor workability make the clay soil a poor subgrade material. Solutioning of the limestone bedrock creates subsurface cavities and causes the development of sinkholes. Construction of highway embankments or foundations requires the repair of sinkholes to minimize the potential of future collapse. Since sinkholes often drain large areas, and are often interconnected through subsurface channels, alteration of the surface

drainage may adversely affect surrounding sinkholes. It is important that sufficient drainage be maintained whenever an existing sinkhole is filled. Development in a sinkhole area is possible if the factors influencing engineering behavior of the soil and bedrock are understood. Special construction techniques are often required.

Miscellaneous

Quarries

Several quarries are located throughout Lawrence County. Most of these are in the limestone plain and are as much as 50 ft (15 m) or more in depth. Some are large; one just northwest of Bedford is over a half square mile (0.64 sq. km) in area. A few small sandstone quarries are identified in the Crawford Upland, where the Mansfield Sandstone is mined as a building material.

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APPENDIX A – Boring and Laboratory Data from the Indiana Geotechnical DataBank.

BORING NO	SAMPLE NO	HIGHWAY ROUTE	STATION NO	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION TEXTURE	AASHTO	GRAIN SIZE DISTRIBUTION GRAV	SAND	SILT	CLAY	PL	LL	PI
1	1	SR-158	766+50	15 L	529.4	0.5- 2.0	Clay Loam	A-6(9)	1.0	25.0	45.0	29.0	17.0	30.0	13.0
2	1	"	786+25	10 L	503.4	0.5- 2.0	Sandy Loam	A-2-4(0)	41.0	34.0	15.0	10.0	19.0	27.0	8.0
2	2	"	786+25	10 L	503.4	11.0-12.0	Clay	A-6(7)	1.0	31.0	37.0	31.0	16.0	28.0	12.0
3	1	"	786+25	35 R	501.1	4.0- 5.5	Silty Clay	A-6(11)	0.0	14.0	54.0	32.0	20.0	37.0	17.0
4	1	"	789+55	10 L	498.5	11.0-13.0	Silty Clay	A-6	0.0	14.0	54.0	32.0	18.0	29.0	11.0
5	1	"	790+55	CL	501.9	14.0-16.5	Clay	A-6	1.0	31.0	37.0	31.0	19.0	30.0	11.0
6	1	"	795+05	CL	498.3	2.0- 4.0	Clay Loam	A-6	1.0	25.0	45.0	29.0	21.0	32.0	11.0
7	1	"	815+00	10 R	524.3	4.0- 5.0	Clay	A-6(11)	3.0	24.0	37.0	36.0	19.0	37.0	18.0
8	1	SR-37	602+50	37 L	732.6	0.6- 4.0	Silty Clay	A-7-6(25)	0.0	1.0	63.0	36.0	22.0	45.0	23.0
9	1	"	609+00	65 L	731.0	7.0- 8.0	Clay	A-7-6(64)	0.0	2.0	29.0	69.0	23.0	80.0	57.0
10	1	"	671+00	37 R	600.1	1.5- 2.3	Clay	A-7-5(53)	0.0	1.0	42.0	57.0	30.0	70.0	45.0
11	1	"	683+95	85 L	624.1	1.0- 2.0	Silty Clay	A-7-6(33)	0.0	1.0	59.0	40.0	23.0	52.0	29.0
12	1	SR-446	18+50	35 L	793.1	8.0-16.0	Clay	A-7-6(20)	1.0	5.0	31.0	63.0	26.0	79.0	53.0
12	2	"	18+50	35 L	793.1	4.0- 6.0	Silty Clay	A-6(13)	1.0	5.0	56.0	38.0	16.0	39.0	23.0
12	3	"	18+50	35 L	793.1	2.0- 3.0	Silty Clay Loam	A-6(10)	0.0	2.0	69.0	29.0	20.0	36.0	16.0
13	1	"	39+65	35 R	785.9	3.0- 5.0	Clay	A-7-6	1.0	5.0	31.0	63.0	26.0	79.0	53.0
13	3	"	39+65	35 R	785.9	8.0- 9.5	Clay	A-7-6	1.0	5.0	31.0	63.0	26.0	79.0	53.0
14	1	"	65+00	CL	786.9	4.0- 5.0	Silty Clay	A-6(11)	0.0	6.0	61.0	33.0	17.0	34.0	17.0
14	2	"	65+00	CL	786.9	1.0- 2.0	Silty Clay Loam	A-6(10)	0.0	7.0	64.0	29.0	22.0	36.0	14.0
15	1	"	72+00	CL	786.0	18.0-21.0	Clay	A-7-6(20)	1.0	4.0	33.0	62.0	26.0	69.0	43.0
16	1	"	125+50	35 L	775.7	8.0- 9.0	Clay, Some Gra	A-7-6(16)	30.0	8.0	16.0	46.0	27.0	79.0	52.0
16	2	"	125+50	35 L	775.7	1.0- 2.0	Silty Clay	A-7-6(13)	0.0	1.0	63.0	36.0	24.0	45.0	21.0
17	1	"	146+70	CL	747.0	1.0- 2.0	Sandy Loam	A-2-6(0)	46.0	24.0	17.0	13.0	22.0	35.0	13.0
18	1	"	157+25	CL	766.5	3.5- 4.0	Silty Clay	A-6(12)	4.0	14.0	50.0	32.0	15.0	34.0	19.0
19	1	"	170+00	CL	816.0	28.0-30.0	Clay Loam	A-4(4)	0.0	44.0	33.0	23.0	12.0	22.0	10.0
19	2	"	170+00	CL	816.0	16.0-18.0	Clay	A-7-6(20)	0.0	6.0	35.0	59.0	25.0	72.0	47.0
19	3	"	170+00	CL	816.0	0.7- 2.0	Silty Clay	A-7-6(15)	0.0	8.0	57.0	35.0	18.0	43.0	25.0
20	1	"	179+45	6 R	773.2	17.0-18.0	Clay	A-6(12)	6.0	10.0	48.0	36.0	17.0	36.0	19.0
21	1	"	183+90	CL	767.3	2.0- 4.0	Clay	A-7-6	0.0	6.0	35.0	59.0	25.0	72.0	47.0
21	2	"	183+90	CL	767.3	6.0- 8.0	Clay	A-7-6	0.0	6.0	35.0	59.0	25.0	72.0	47.0
22	1	"	235+00	CL	710.9	3.0- 4.0	Clay	A-7-5(20)	0.0	2.0	29.0	69.0	35.0	84.0	49.0
23	1	"	228+50	CL	664.5	1.0- 2.5	Silty Clay	A-7-6(13)	1.0	6.0	54.0	39.0	23.0	44.0	21.0
25	1	"	241+50	35 R	714.0	1.0- 2.0	Silty Clay	A-7-6(14)	0.0	6.0	62.0	32.0	19.0	43.0	24.0
26	1	"	259+00	CL	738.6	1.0- 2.0	Silty Clay	A-6(9)	1.0	7.0	61.0	31.0	22.0	35.0	13.0
27	1	"	287+75	CL	733.2	10.5-11.0	Silty Clay	A-7-6(14)	11.0	5.0	51.0	33.0	19.0	43.0	24.0
27	2	"	287+75	CL	733.2	4.0- 5.0	Silty Clay	A-6(11)	1.0	4.0	59.0	36.0	20.0	38.0	18.0
28	1	"	300+85	CL	669.0	3.0- 5.0	Silty Clay	A-6	1.0	4.0	59.0	36.0	20.0	38.0	18.0
29	1	"	309+50	35 R	720.4	8.0-10.0	Sandy Clay Loam	A-4(2)	2.0	53.0	21.0	24.0	14.0	18.0	4.0
29	2	"	309+50	35 R	720.4	4.0- 6.0	Clay	A-7-5(20)	0.0	4.0	47.0	49.0	31.0	69.0	38.0
30	1	"	325+00	35 R	626.1	0.0- 2.0	Silty Loam	A-4(8)	2.0	7.0	73.0	18.0	26.0	32.0	6.0
31	2	"	328+15	6 R	588.5	15.0-17.0	Clay	A-7-6	10.0	17.0	38.0	35.0	21.0	41.0	20.0
31	3	"	328+15	6 R	588.5	13.5-15.0	Clay	A-7-6(13)	10.0	17.0	38.0	35.0	19.0	41.0	22.0
32	1	"	328+10	6 R	588.5	10.0-12.0	Clay	A-7-6	10.0	17.0	38.0	35.0	19.0	41.0	22.0
32	2	"	328+10	6 R	588.5	18.0-20.0	Clay	A-7-6	10.0	17.0	38.0	35.0	21.0	41.0	20.0
32	3	"	328+10	6 R	588.5	21.0-23.0	Clay	A-7-6	10.0	17.0	38.0	35.0	19.0	41.0	22.0
32	4	"	328+10	6 R	588.5	26.0-28.0	Clay	A-7-6	10.0	17.0	38.0	35.0	19.0	41.0	22.0

APPENDIX A – Continued

BORING NO	SAMPLE NO	HIGHWAY ROUTE	STATION NO	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION: TEXTURE	SOIL DESCRIPTION: AASHTO	GRAIN SIZE DISTRIBUTION: GRAV	GRAIN SIZE DISTRIBUTION: SAND	GRAIN SIZE DISTRIBUTION: SILT	GRAIN SIZE DISTRIBUTION: CLAY	PL	LL	PI
33	1	SR-446	339+00	CL	566.0	9.0-10.0	Silty Clay	A-7-6(11)	3.0	6.0	59.0	32.0	24.0	41.0	17.0
34	1	"	362+05	5 R	547.7	3.0- 5.0	Clay	A-7-6	10.0	17.0	38.0	35.0	19.0	41.0	22.0
34	2	"	362+05	5 R	547.7	5.5- 6.5	Clay	A-7-6	10.0	17.0	38.0	35.0	19.0	41.0	22.0
35	1	"	366+00	CL	547.2	3.5- 5.0	Silty Clay	A-4(8)	2.0	15.0	53.0	30.0	22.0	29.0	7.0
36	1	"	372+05	CL	551.4	4.0- 6.0	Clay	A-7-6	3.0	6.0	52.0	32.0	24.0	41.0	17.0
37	1	"	380+40	CL	558.5	8.0- 9.0	Silty Clay Loam	A-4(8)	0.0	3.0	73.0	24.0	22.0	31.0	9.0
38	1	"	384+30	20 R	553.4	12.0-12.5	Sandy Loam, Gra	A-4(1)	29.0	30.0	29.0	12.0	23.0	33.0	10.0
39	1	"	387+00	CL	553.0	3.0- 5.0	Silty Clay Loam	A-4	0.0	3.0	73.0	24.0	22.0	31.0	9.0
40	1	"	416+05	CL	566.4	4.0- 6.0	Silty Clay Loam	A-4	0.0	3.0	73.0	24.0	22.0	31.0	9.0
41	1	"	434+00	CL	628.0	4.0- 5.0	Silty Clay Loam	A-6(8)	8.0	12.0	52.0	28.0	19.0	30.0	11.0
43	1	"	466+05	CL	586.0	2.0- 2.8	Silty Clay Loam	A-6	8.0	12.0	52.0	28.0	19.0	30.0	11.0
44	1	"	470+20	40 L	653.4	2.0- 3.0	Sandy Clay, Gra	A-7-6(11)	38.0	12.0	20.0	30.0	25.0	55.0	30.0
45	1	SR-37	242+27	65 R	492.9	10.0-12.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	--	--	--
45	2	"	242+27	65 R	492.9	15.0-17.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	20.6	33.4	12.8
46	1	"	244+15	20 L	486.5	17.5-19.0	Silt	A-4(8)	0.0	4.0	80.0	16.0	22.0	26.0	4.0
46	2	"	244+15	20 L	486.5	30.0-31.5	Silt	A-4(8)	0.0	7.0	81.0	12.0	21.0	22.0	1.0
47	1	"	244+85	65 L	494.5	5.0- 7.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	23.3	24.5	1.2
47	2	"	244+85	65 L	494.5	5.0- 7.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	23.3	24.5	1.2
47	3	"	244+85	65 L	494.5	5.0- 7.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	--	--	--
47	4	"	244+85	65 L	494.5	15.0-17.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	22.0	26.5	4.5
47	5	"	244+85	65 L	494.5	15.0-17.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	22.0	26.5	4.5
47	6	"	244+85	65 L	494.5	15.0-17.0	Silty Clay Loam	A-4(5-8)	--	--	--	--	22.0	26.5	4.5
47	7	"	244+85	65 L	494.5	20.0-22.0	Silt	A-4(5-8)	--	--	--	--	--	--	NP
47	8	"	244+85	65 L	494.5	20.0-22.0	Silt	A-4(5-8)	--	--	--	--	--	--	NP
47	9	"	244+85	65 L	494.5	20.0-22.0	Silt	A-4(5-8)	--	--	--	--	--	--	--
48	1	"	53+50	75 R	622.9	0.5- 4.0	Silty Clay Loam	A-4(8)	0.0	3.0	72.0	25.0	23.0	33.0	10.0
49	1	"	59+00	75 L	626.4	0.4- 1.5	Silty Clay Loam	A-4(8)	0.0	4.0	72.0	24.0	21.0	30.0	9.0
49	2	"	59+00	75 L	626.4	22.0-23.0	Clay	A-7-6(20)	0.0	9.0	36.0	55.0	23.0	66.0	43.0
50	1	"	64+00	CL	625.3	12.5-14.0	Clay	A-7-5(20)	0.0	2.0	27.0	71.0	32.0	79.0	47.0
50	2	"	64+00	CL	625.3	10.0-11.5	Clay, Some Gra	A-7-6(20)	16.0	3.0	31.0	50.0	25.0	61.0	36.0
51	1	"	73+00	100 L	662.0	9.0-10.0	Clay, Some Gra	A-6(12)	12.0	20.0	36.0	32.0	17.0	40.0	23.0
52	1	"	76+60	42 R	615.0	0.0- 2.0	Silty Loam	A-7-6(9)	4.0	9.0	68.0	19.0	28.0	41.0	13.0
53	1	"	83+00	75 L	660.8	4.5- 7.5	Clay	A-7-6(20)	0.0	4.0	34.0	62.0	25.0	64.0	39.0
53	2	"	83+00	75 L	660.8	11.0-12.0	Silt, Trace Gra	A-6(8)	2.0	10.0	52.0	36.0	18.0	29.0	11.0
54	1	"	88+00	75 R	640.3	0.5- 1.5	Silty Clay	A-6(9)	0.0	4.0	65.0	31.0	23.0	35.0	12.0
54	2	"	88+00	75 R	640.3	9.0-10.0	Clay, Trace Gra	A-7-6(20)	2.0	9.0	37.0	52.0	21.0	58.0	37.0
55	1	"	91+35	75 L	602.2	5.0- 7.0	Silty Clay Loam	A-4(5-8)	0.0	20.0	55.0	25.0	22.4	25.7	3.3
55	2	"	91+35	75 L	602.2	10.0-12.0	Clay	A-7-6(16-20)	0.0	13.0	63.0	24.0	22.1	49.5	27.4
56	1	"	97+30	CL	637.3	6.0- 7.0	Clay	A-7-6(20)	0.0	4.0	39.0	57.0	23.0	58.0	35.0
56	2	"	97+30	CL	637.3	1.0- 2.0	Silty Clay Loam	A-4(8)	0.0	20.0	55.0	25.0	21.0	27.0	6.0
57	1	"	143+00	75 L	678.0	14.0-16.0	Clay, Trace Gra	A-7-6(20)	4.0	6.0	21.0	69.0	24.0	73.0	49.0
58	1	"	146+25	CL	647.4	4.0- 6.0	Silty Clay Loam	A-4(8)	0.0	2.0	76.0	22.0	22.0	29.0	7.0
59	1	"	150+50	75 L	688.0	18.0-20.0	Clay	A-7-6(20)	0.0	3.0	27.0	70.0	24.0	59.0	35.0
60	1	"	156+50	42 R	677.3	4.0-12.0	Clay, Some Gra	A-7-6(20)	18.0	10.0	22.0	51.0	23.0	65.0	42.0
60	2	"	156+50	42 R	677.3	12.0-18.0	Clay, Trace Gra	A-7-6(20)	3.0	3.0	24.0	70.0	29.0	83.0	54.0
61	1	"	164+85	75 R	659.3	6.0- 7.0	Clay	A-7-6(20)	0.0	5.0	30.0	65.0	23.0	63.0	40.0

APPENDIX A - Continued

BORING NO	SAMPLE NO	HIGHWAY ROUTE	STATION NO.	OFFSET (ft)	GROUND ELEV. (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				PL	LL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
62	1	SR-37	203+25	42 L	623.7	3.0- 4.0	Clay	A-7-6(19)	0.0	4.0	48.0	48.0	23.0	54.0	31.0
63	1	"	206+37	75 R	633.9	4.0- 5.0	Sandy Loam, Gra	A-6(4)	41.0	13.0	28.0	18.0	20.0	34.0	14.0
63	2	"	206+37	75 R	633.9	10.0-11.0	Clay	A-7-6(20)	0.0	4.0	37.0	59.0	26.0	66.0	40.0
63	3	"	206+37	75 R	633.9	19.0-20.0	Clay	A-7-6(18)	0.0	5.0	48.0	47.0	18.0	49.0	31.0
64	1	"	217+00	42 R	637.4	1.5- 3.0	Silty Clay	A-6(10)	0.0	2.0	63.0	35.0	21.0	36.0	15.0
65	1	"	246+00	CL	496.1	5.0- 7.0	Silty Clay Loam	A-4(5-8)	0.0	13.0	63.0	24.0	22.1	49.5	27.4
65	2	"	246+00	CL	496.1	10.0-12.0	Silty Clay Loam	A-4(5-8)	0.0	13.0	63.0	24.0	21.0	26.6	5.6
65	3	"	246+00	CL	496.1	30.0-32.0	Loam	A-4(0-4)	12.0	36.0	35.0	17.0	20.8	24.7	3.9
66	1	"	248+00	CL	490.3	7.5- 9.0	Silty Clay Loam	A-6(10)	0.0	13.0	63.0	24.0	22.0	30.0	8.0
66	2	"	248+00	CL	490.3	17.5-19.5	Silt	A-4(8)	0.0	4.0	80.0	16.0	24.4	26.5	2.1
67	1	"	275+00	CL	487.0	17.5-19.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	15.5	25.8	10.3
68	1	"	280+15	42 L	484.2	7.5- 9.0	Silty Clay Loam	A-6(10)	0.0	8.0	68.0	24.0	23.0	37.0	14.0
68	2	"	280+15	42 L	484.2	12.5-13.5	Loam	A-4(3)	12.0	36.0	35.0	17.0	16.0	20.0	4.0
68	3	"	280+15	42 L	484.2	17.5-19.0	Clay	A-7-6(14)	0.0	1.0	20.0	79.0	22.0	45.0	23.0
69	1	"	286+00	42 L	487.7	17.5-19.0	Sandy Loam, Gra	A-4(3)	30.0	22.0	36.0	12.0	20.0	28.0	8.0
69	2	"	286+00	42 L	487.7	10.0-12.0	Silty Clay Loam	A-6(0-10)	0.0	8.0	68.0	24.0	19.1	44.0	24.9
69	3	"	286+00	42 L	487.7	10.0-12.0	Silty Clay Loam	A-6(0-10)	0.0	8.0	68.0	24.0	19.1	44.0	24.9
69	4	"	286+00	42 L	487.7	10.0-12.0	Silty Clay Loam	A-6(0-10)	0.0	8.0	68.0	24.0	19.1	44.0	24.9
69	5	"	286+00	42 L	487.7	10.0-12.0	Silty Clay Loam	A-6(0-10)	0.0	8.0	68.0	24.0	19.1	44.0	24.9
69	6	"	286+00	42 L	487.7	30.0-32.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	22.4	45.9	23.5
69	7	"	286+00	42 L	487.7	30.0-32.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	22.4	45.9	23.5
69	8	"	286+00	42 L	487.7	30.0-32.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	22.4	45.9	23.5
69	9	"	286+00	42 L	487.7	30.0-32.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	22.4	45.9	23.5
70	1	"	291+00	42 L	489.7	12.5-14.0	Silty Clay	A-6(13)	0.0	4.0	57.0	39.0	20.0	42.0	22.0
70	2	"	291+00	42 L	489.7	17.0-19.0	Sandy Loam, Gra	A-4(0-4)	30.0	22.0	36.0	12.0	20.8	34.0	13.2
70	3	"	291+00	42 L	489.7	26.0-28.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	20.9	32.6	11.7
70	4	"	291+00	42 L	489.7	26.0-28.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	20.9	32.6	11.7
70	5	"	291+00	42 L	489.7	26.0-28.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	20.9	32.6	11.7
70	6	"	291+00	42 L	489.7	26.0-28.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	20.9	32.6	11.7
71	1	"	296+00	42 L	491.6	17.0-19.0	Silty Clay	A-7-6(8-15)	0.0	4.0	57.0	39.0	23.5	49.4	25.9
72	1	"	302+00	42 L	491.6	23.0-24.5	Sandy Loam, Gra	A-1-b(0)	54.0	24.0	15.0	7.0	16.0	19.0	3.0
72	2	"	302+00	42 L	491.6	2.5- 4.5	Silty Clay Loam	A-6(0-10)	0.0	8.0	68.0	24.0	22.5	30.5	8.0
72	3	"	302+00	42 L	491.6	2.5- 4.5	Silty Clay Loam	A-6(0-10)	0.0	8.0	68.0	24.0	22.5	30.5	8.0
72	4	"	302+00	42 L	491.6	2.5- 4.5	Silty Clay Loam	A-6(0-10)	0.0	8.0	68.0	24.0	22.5	30.5	8.0
72	5	"	302+00	42 L	491.6	2.5- 4.5	Silty Clay Loam	A-6(0-10)	0.0	9.0	68.0	24.0	22.5	30.5	8.0
72	6	"	302+00	42 L	491.6	17.0-19.0	Clay	A-7-6(8-18)	0.0	1.0	20.0	79.0	24.5	35.1	10.6
72	7	"	302+00	42 L	491.6	17.0-19.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	24.5	35.1	10.6
72	8	"	302+00	42 L	491.6	17.0-19.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	24.5	35.1	10.6
72	9	"	302+00	42 L	491.6	22.0-23.0	Clay	A-7-6(8-15)	0.0	1.0	20.0	79.0	22.9	33.6	10.7
73	1	"	310+00	42 L	493.1	10.0-11.5	Loam, Some Gra	A-4(3)	30.0	20.0	34.0	16.0	18.0	26.0	8.0
74	1	"	310+00	140 L	494.0	10.0-11.5	Sandy Gravel	A-1-a(0)	65.0	25.0	6.0	4.0	--	--	NP
74	2	"	310+00	140 L	494.0	27.5-29.0	Sandy Gravel	A-1-a(0)	60.0	27.0	8.0	5.0	15.0	16.0	1.0
75	1	"	314+00	75 L	495.5	12.0-13.5	Silty Clay Loam	A-4(8)	0.0	24.0	55.0	21.0	18.0	24.0	6.0
75	2	"	314+00	75 L	495.5	5.0- 6.5	Clay	A-7-6(16-20)	1.0	6.0	33.0	60.0	17.9	34.5	16.6
75	3	"	314+00	75 L	495.5	10.0-12.0	Silty Clay	A-4(5-8)	5.0	27.0	47.0	21.0	20.0	30.0	10.0
75	4	"	314+00	75 L	495.5	10.0-12.0	Silty Clay	A-4(5-8)	5.0	27.0	47.0	21.0	20.0	30.0	10.0

APPENDIX A – Continued

BORING NO	SAMPLE NO.	HIGHWAY ROUTE	STATION NO	OFFSET (ft)	GROUND ELEV (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				PL	LL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
75	5	SR-37	314+00	75 L	495 5	10 0-12 0	Silty Clay	A-4(5-8)	5 0	27 0	47 0	21.0	20.0	30 0	10 0
75	6	"	314+00	75 L	495 5	10 0-12 0	Silty Clay	A-4(5-8)	5 0	27 0	47.0	21 0	20.0	30 0	10 0
76	1	"	318+00	100 L	497 1	2 5- 4 0	Silty Clay Loam	A-6(10)	0 0	6 0	67.0	27.0	22 0	36 0	14 0
77	1	"	330+00	42 R	539 5	0 0- 2 0	Clay, Trace Gra	A-7-6(20)	1 0	6 0	33 0	60.0	24 0	58 0	34 0
78	1	"	334+50	150 L	502 0	4 0- 6 0	Clay Loam	A-4(7)	5 0	27 0	47 0	21 0	21 0	26 0	5 0
79	1	"	375+00	75 R	603 3	4 0-10 0	Clay	A-7-6(20)	0 1	2 9	25 0	72.0	24 0	67 0	43 0
80	1	"	380+00	75 R	611 2	21 0-22 0	Clay	A-6(11)	1.0	16.0	45 0	38.0	21.0	40 0	19 0
80A	1	"	394+00	75 R	657 0	12.0-14 0	Clay, Trace Gra	A-6(9)	7 0	24 0	36 0	33 0	15 0	31 0	16 0
80B	1	"	402+00	75 R	682 0	0.5- 4 0	Silty Clay	A-6(9)	0 0	3 0	62 0	35 0	20 0	32 0	12 0
81	1	"	421+50	75 R	702.0	0.5- 2 0	Silty Clay	A-6(12)	0.1	1.9	60 0	38 0	18 0	38 0	20 0
82	1	"	430+50	42 L	643 7	3 0- 5 0	Clay	A-7-6(17)	1 0	6.0	43 0	50 0	19 0	47.0	28 0
83	1	"	435+50	75 R	687 2	4.0- 6 0	Silty Clay	A-6(10)	3 0	9 0	55 0	33 0	16 0	31 0	15 0
84	1	"	443+75	42 L	655 0	7.5- 9 0	Clay Loam, Gra	A-6(10)	9.5	15 5	48 0	27.0	20 0	34 0	14 0
85	1	"	482+00	75 R	683 7	5.0- 6 0	Clay, Trace Gra	A-7-6(16)	8 0	18.0	28.0	46.0	16 0	44 0	28 0
86	1	"	488+50	42 L	657 5	4 0- 5 0	Silty Clay	A-4(8)	0.0	3 0	63.0	34 0	20 0	30 0	10 0
87	1	"	497+00	85 R	680 1	12.5-15 0	Clay, Trace Gra	A-7-6(15)	1 0	4.0	42 0	53 0	18 0	44 0	26 0
87	2	"	497+00	85 R	680 1	7.5-12.5	Clay, Trace Gra	A-7-6(20)	9.0	10 0	22 0	59 0	22 0	60 0	38 0
88	1	"	560+00	75 L	711 2	10.0-11 0	Clay, Trace Gra	A-7-6(20)	2.0	5.0	19.0	74 0	22 0	68 0	46 0
89	1	"	568+15	CL	686.5	4 0- 5 0	Silty Clay Loam	A-4(8)	0 0	7 0	67.0	26 0	23 0	31 0	8 0
90	1	"	574+00	75 L	740 0	0.5- 3 5	Silty Clay Loam	A-6(9)	0.0	5.0	65.0	30 0	21 0	32 0	11 0
90	2	"	574+00	75 L	740 0	18 5-19 5	Clay	A-7-6(19)	0 0	32 0	26 0	42.0	16 0	65 0	49 0
91	1	SR-450	496+00	CL	494 7	23.5-25 0	Loam	A-4(4)	30.0	6 0	48 0	16.0	19.0	29 0	10 0
92	1	"	492+00	CL	491 7	8 0-10 0	Silty Clay	A-7-6(17)	0.0	2.0	62.0	36.0	26.0	41 0	15 0
92	2	"	492+00	CL	491 7	8 0-10 0	Silty Clay	A-7-6(17)	0.0	2.0	62.0	36 0	26 0	41 0	15 0
92	3	"	492+00	CL	491 7	20.0-22 0	Silty Clay Loam	A-6(13)	0 0	2 0	70.0	28.0	17.0	30 0	13 0
92	7	"	492+00	CL	491 7	8 0-10 0	Silty Clay	A-7-6(17)	0 0	2.0	62 0	36 0	26 0	41 0	15 0
92A	1	"	492+00	CL	492 3	60.0-62 0	Clay	A-6(14)	0 0	1 0	39 0	60.0	24 0	38 0	14 0
92A	2	"	492+00	CL	492 3	35.0-37 0	Clay	A-4(7)	0.0	2.0	78 0	20.0	22 0	29 0	7 0
93	1	"	496+93	21 L	487.7	16 0-18 0	Silty Clay Loam	A-4(7)	--	--	--	--	24 0	38 0	14 0
93	2	"	496+93	21 L	487 7	16.0-18 0	Silty Clay Loam	A-4(7)	--	--	--	--	24 0	38 0	14 0
93	3	"	496+93	21 L	487 7	16 0-18 0	Silty Clay Loam	A-4(7)	--	--	--	--	24 0	38 0	14 0
93	4	"	496+93	21 L	487 7	16 0-18 0	Silty Clay Loam	A-4(7)	--	--	--	--	24 0	38 0	14 0
93	5	"	496+93	21 L	487 7	31 0-33 0	Clay	A-6(14)	--	--	--	--	24 0	38 0	14 0
93	6	"	496+93	21 L	487 7	31 0-33 0	Clay	A-6(14)	--	--	--	--	24 0	38 0	14 0
93	7	"	496+93	21 L	487 7	51.0-53 0	Clay	A-6(14)	--	--	--	--	24 0	38 0	14 0
93	8	"	496+93	21 L	487 7	51.0-53 0	Clay	A-6(14)	--	--	--	--	24 0	38 0	14 0
93	9	"	496+93	21 L	487 7	51 0-53 0	Clay	A-6(14)	--	--	--	--	24 0	38 0	14 0
93	10	"	496+93	21 L	487 7	31 0-33 0	Clay	A-6(14)	--	--	--	--	24 0	38 0	14 0
94	2	"	498+55	CL	487 5	23 0-25 0	Silty Clay Loam	A-4(7)	0 0	2.0	78.0	20 0	23 0	33 0	10 0
94	3	"	498+55	CL	487 5	23 0-25 0	Silty Clay Loam	A-4(7)	0.0	2.0	78 0	20 0	22 0	29 0	7 0
94	4	"	498+55	CL	487 5	23 0-25 0	Silty Clay Loam	A-4(7)	0 0	2 0	78 0	20 0	22 0	29 0	7 0
95	1	"	502+50	CL	499 4	6 0- 7 5	Silt	A-4(9)	0 0	1 0	85 0	14 0	19 0	29 0	10 0
95	2	"	502+50	CL	499 4	3 5- 5 0	Silty Clay	A-7-6(17)	0 0	2 0	62 0	36.0	26 0	41 0	15 0
96	1	"	514+39	CL	566 3	5 0- 5 5	Clay	A-7-6(38)	0 0	3.0	25 0	72 0	26 0	60 0	34 0
97	1	"	519+95	CL	645 8	13.5-18 5	Clay	A-7-6(66)	0.0	0 0	42 0	58.0	22 0	79 0	57 0
98	1	"	538+25	35 R	616 0	2.0- 4 0	Silty Clay Loam	A-6(13)	5 0	6.0	60 0	29 0	20 0	35 0	15 0

APPENDIX A - Continued

BORING NO	SAMPLE NO.	HIGHWAY ROUTE	STATION NO.	OFFSET (ft)	GROUND ELEV (ft)	SAMPLE DEPTH (ft)	SOIL DESCRIPTION		GRAIN SIZE DISTRIBUTION				PL	LL	PI
							TEXTURE	AASHTO	GRAV	SAND	SILT	CLAY			
99	1	US-50	1070+00	70 L	624.0	1.0- 5.0	Clay	A-7-6	--	--	--	--	--	--	--
100	1	"	1078+50	70 L	676.0	2.5- 5.0	Silty Loam	A-4(0)	0.0	32.0	53.0	15.0	20.0	22.0	2.0
101	1	"	1125+00	155 L	555.0	4.8- 5.0	Silty Clay Loam	A-6(11)	0.0	12.0	59.0	29.0	19.5	32.4	12.9
102	1	"	1135+05	80 L	575.0	13.0-15.0	Clay Loam	A-4	--	--	--	--	51.0	62.0	31.0
102	2	"	1135+05	80 L	575.0	18.0-20.0	Silty Clay Loam	A-6	--	--	--	--	--	--	--
103	1	"	1135+00	80 L	575.0	18.0-20.0	Silty Clay Loam	A-6	--	--	--	--	31.0	62.0	51.0
103	2	"	1135+00	80 L	575.0	18.0-20.0	Silty Clay Loam	A-6	--	--	--	--	31.0	62.0	51.0
103	3	"	1135+00	80 L	575.0	18.0-20.0	Silty Clay Loam	A-6	--	--	--	--	31.0	62.0	51.0
104	1	"	1139+00	100 L	571.0	8.5-10.0	Clay Loam	A-4(4)	0.0	33.0	44.0	23.0	15.0	25.0	10.0
104	2	"	1139+00	100 L	571.0	13.0-15.0	Silty Clay Loam	A-6	--	--	--	--	--	--	--
105	1	"	1139+05	100 L	571.0	8.0-10.0	Clay Loam, Gra	A-4(4)	--	--	--	--	--	--	--
105	2	"	1139+05	100 L	571.0	13.0-15.0	Clay Loam, Gra	A-6	--	--	--	--	--	--	--
106	1	"	1139+00	40 R	573.0	7.0- 9.0	Clay Loam	A-4	--	--	--	--	--	--	--
107	1	"	1204+50	80 R	818.0	1.0- 4.0	Silty Clay Loam	A-6	--	--	--	--	--	--	--
108	1	"	1212+00	70 L	674.0	8.5-10.0	Clay	A-7-6(26)	0.0	13.0	34.0	53.0	22.2	50.3	28.1
108	2	"	1212+00	70 L	674.0	3.0- 5.0	Sandy Clay	A-6	--	--	--	--	--	--	--
109	1	"	1212+07	70 L	674.0	2.0- 4.0	Sandy Clay	A-6	--	--	--	--	--	--	--
109	2	"	1212+07	70 L	674.0	2.0- 4.0	Sandy Clay	A-6	--	--	--	--	--	--	--
110	1	"	1212+05	70 L	674.0	3.0- 5.0	Sandy Clay	A-6	--	--	--	--	--	--	--
111	1	"	1215+55	70 R	707.5	1.0- 3.0	Sandy Clay	A-6	--	--	--	--	--	--	--
112	1	"	1225+50	60 L	730.0	7.0- 8.0	Sandy Clay	A-6(5)	0.0	54.0	15.0	31.0	19.7	38.0	18.3
113	1	"	1349+00	42 L	578.0	2.0- 4.0	Silty Clay Loam	A-6(16)	0.0	9.0	65.0	26.0	18.1	36.1	18.0
114	1	SR-54	1180+74	24 L	592.9	0.0- 4.2	Silty Loam	A-4(4)	0.1	29.1	58.1	12.7	19.4	28.2	8.9

APPENDIX B - Special Laboratory Data Compiled from References 22-29.

BORING NO	SAMPLE NO	HIGHWAY ROUTE	STATION NO	SAMPLE DEPTH (ft)	AASHTO CLASS.	SHEAR STRENGTH			CONSOLIDATION DATA				G_s	COMPACTION DATA		
						TEST TYPE	ϕ	c (tsf)	σ'_{vo} (tsf)	σ'_p (tsf)	c_c	c_r		$\gamma_{d\,max}$ (pcf)	w_{opt} (%)	CBR (%)
4	1	SR-158	789+55	11.0-13.0	A-6	Unconf	--	0.63	0.61	1.90	0.220	0.030	2.62	--	--	--
5	1	"	790+55	14.0-16.5	A-6	Unconf	--	1.05	--	--	--	--	--	--	--	--
6	1	"	795+05	2.0- 4.0	A-6	Unconf	--	0.41	0.18	1.50	0.290	0.030	2.63	--	--	--
8	1	SR-37	602+50	0.6- 4.0	A-7-6(25)	--	--	--	--	--	--	--	--	103.5	17.6	4.7
13	1	SR-446	39+65	3.0- 5.0	A-7-6	Unconf	--	1.52	--	--	--	--	--	--	--	--
13	3	"	39+65	8.0- 9.5	A-7-6	Unconf	--	1.16	--	--	--	--	--	--	--	--
15	1	"	72+00	18.0-21.0	A-7-6(20)	--	--	--	--	--	--	--	--	102.6	21.0	3.5
21	1	"	183+90	2.0- 4.0	A-7-6	Unconf	--	1.17	--	--	--	--	--	--	--	--
21	2	"	183+90	6.0- 8.0	A-7-6	Unconf	--	3.96	--	--	--	--	--	--	--	--
28	1	"	300+85	3.0- 5.0	A-6	Unconf	--	0.54	--	--	--	--	--	--	--	--
31	2	"	323+15	15.0-17.0	A-7-6	Unconf	--	0.46	0.73	0.73	0.220	0.020	2.72	--	--	--
32	1	"	328+10	10.0-12.0	A-7-6	Unconf	--	0.44	--	--	--	--	--	--	--	--
32	2	"	328+10	18.0-20.0	A-7-6	Unconf	--	0.26	--	--	--	--	--	--	--	--
32	3	"	328+10	21.0-23.0	A-7-6	Unconf	--	0.32	--	--	--	--	--	--	--	--
32	4	"	328+10	26.0-28.0	A-7-6	Unconf	--	0.37	--	--	--	--	--	--	--	--
34	1	"	362+05	3.0- 5.0	A-7-6	Unconf	--	0.38	--	--	--	--	--	--	--	--
34	2	"	362+05	5.5- 6.5	A-7-6	Unconf	--	1.74	--	--	--	--	--	--	--	--
36	1	"	372+05	4.0- 6.0	A-7-6	Unconf	--	1.39	--	--	--	--	--	--	--	--
39	1	"	387+00	3.0- 5.0	A-4	Unconf	--	0.92	--	--	--	--	--	--	--	--
40	1	"	416+05	4.0- 6.0	A-4	Unconf	--	1.37	--	--	--	--	--	--	--	--
43	1	"	466+05	2.0- 2.8	A-6	Unconf	--	0.43	--	--	--	--	--	--	--	--
45	1	SR-37	242+27	10.0-12.0	A-4(5-8)	UU-Trx	--	1.03	--	--	--	--	--	--	--	--
45	2	"	242+27	15.0-17.0	A-4(5-8)	UU-Trx	--	1.73	--	--	--	--	--	--	--	--
47	1-3	"	244+85	5.0- 7.0	A-4(5-8)	UU-Trx	20.0	0.25	--	--	--	--	--	--	--	--
47	4-6	"	244+85	15.0-17.0	A-4(5-8)	UU-Trx	10.0	0.28	--	--	--	--	--	--	--	--
47	7-9	"	244+85	20.0-22.0	A-4(5-8)	UU-Trx	0.0	0.27	--	--	--	--	--	--	--	--
48	1	"	53+50	0.5- 4.0	A-4(8)	--	--	--	--	--	--	--	--	106.3	18.0	9.2
53	1	"	83+00	4.5- 7.5	A-7-6(20)	--	--	--	--	--	--	--	--	96.2	24.8	3.1
55	1	"	91+35	5.0- 7.0	A-4(5-8)	Unconf	--	0.64	0.30	1.60	0.198	0.012	2.68	--	--	--
55	2	"	91+35	10.0-12.0	A-7-6(16-20)	Unconf	--	1.65	--	--	--	--	--	--	--	--
60	1	"	156+50	4.0-12.0	A-7-6(20)	--	--	--	--	--	--	--	--	97.9	24.3	2.2
60	2	"	156+50	12.0-18.0	A-7-6(20)	--	--	--	--	--	--	--	--	99.8	24.0	2.7
65	1	"	246+00	5.0- 7.0	A-4(5-8)	Unconf	--	1.26	--	--	--	--	--	--	--	--
65	2	"	246+00	10.0-12.0	A-4(5-8)	Unconf	--	1.02	0.75	2.80	0.132	0.010	2.68	--	--	--
65	3	"	246+00	30.0-32.0	A-4(0-4)	Unconf	--	0.52	1.30	2.50	0.133	0.013	2.72	--	--	--
66	2	"	246+00	17.5-19.5	A-4(8)	Unconf	--	0.76	--	--	--	--	--	--	--	--
67	1	"	275+00	17.5-19.0	A-7-6(8-15)	Unconf	--	0.49	--	--	--	--	--	--	--	--
69	2	"	286+00	10.0-12.0	A-6(0-10)	Unconf	--	0.28	--	--	--	--	--	--	--	--
69	3-5	"	286+00	10.0-12.0	A-6(0-10)	UU-Trx	2.0	0.14	--	--	--	--	--	--	--	--
69	6	"	286+00	30.0-32.0	A-7-6(8-15)	Unconf	--	1.03	1.20	1.20	0.300	0.050	2.75	--	--	--
69	7-9	"	286+00	30.0-32.0	A-7-6(8-15)	CU-Trx	18.2	0.00	--	--	--	--	--	--	--	--
70	3	"	291+00	26.0-28.0	A-7-6(8-15)	Unconf	--	0.60	--	--	--	--	--	--	--	--
70	4-6	"	291+00	26.0-28.0	A-7-6(8-15)	UU-Trx	11.0	0.26	--	--	--	--	--	--	--	--
71	1	"	296+00	17.0-19.0	A-7-6(8-15)	Unconf	--	0.49	0.70	1.10	0.318	0.060	2.74	--	--	--
72	2	"	302+00	2.5- 4.5	A-6(0-10)	Unconf	--	0.12	--	--	--	--	--	--	--	--
72	3-5	"	302+00	2.5- 4.5	A-6(0-10)	UU-Trx	--	0.15	0.20	0.63	0.210	0.007	2.70	--	--	--

APPENDIX B - Continued

BORING NO	SAMPLE NO	HIGHWAY ROUTE	STATION NO	SAMPLE DEPTH (ft)	AASHTO CLASS	SHEAR STRENGTH			CONSOLIDATION DATA				G_s	COMPACTION DATA		
						TEST TYPE	ϕ	c (tsf)	σ_{vo} (tsf)	σ'_p (tsf)	c_c	c_r		$\gamma_{d_{max}}$ (pcf)	w_{opt} (%)	CBR (%)
72	6-8	SR-37	302+00	17.0-19.0	A-7-6(8-15)	CU-Trx	25.0	0.00	--	--	--	--	--	--	--	--
72	9	"	302+00	22.0-23.0	A-7-6(8-15)	Unconf	--	0.85	0.66	1.20	0.254	0.017	2.75	--	--	--
75	2	"	314+00	5.0- 6.5	A-7-6(16-20)	Unconf	--	0.37	--	--	--	--	--	--	--	--
75	3	"	314+00	10.0-12.0	A-4(5-8)	Unconf	--	0.51	0.40	2.30	0.190	--	2.78	--	--	--
75	5-6	"	314+00	10.0-12.0	A-4(5-8)	CU-Trx	20.8	0.35	--	--	--	--	--	--	--	--
79	1	"	375+00	4.0-10.0	A-7-6(20)	--	--	--	--	--	--	--	--	--	--	--
80B	1	"	402+00	0.5- 4.0	A-6(9)	--	--	--	--	--	--	--	--	95.2	27.0	3.4
87	1	"	497+00	12.5-15.0	A-7-6(15)	--	--	--	--	--	--	--	--	107.0	17.8	5.4
87	2	"	497+00	7.5-12.5	A-7-6(20)	--	--	--	--	--	--	--	--	106.2	19.5	1.9
90	1	"	574+00	0.5- 3.5	A-6(9)	--	--	--	--	--	--	--	--	100.3	22.3	3.1
92	1	SR-450	492+00	8.0-10.0	A-7-6(17)	CU-Trx	--	1.70	--	--	--	--	--	108.4	17.5	13.0
92	2	"	492+00	8.0-10.0	A-7-6(17)	CU-Trx	--	2.40	--	--	--	--	--	--	--	--
92	3	"	492+00	20.0-22.0	A-6(13)	Unconf	--	0.28	--	--	--	--	--	--	--	--
92	7	"	492+00	8.0-10.0	A-7-6(17)	Unconf	--	0.76	--	--	--	--	--	--	--	--
92H	1	"	492+00	60.0-62.0	A-6(14)	--	--	--	2.20	2.20	0.170	--	2.51	--	--	--
92A	2	"	492+00	35.0-37.0	A-4(7)	Unconf	--	0.31	--	--	--	--	--	--	--	--
92B	1	"	493+15	20.0-22.0	A-4(7)	CU-Trx	35.0	0.00	--	--	--	--	--	--	--	--
93	1	"	496+93	16.0-18.0	A-4(7)	Unconf	--	0.81	--	--	--	--	--	--	--	--
93	2-4	"	496+93	16.0-18.0	A-4(7)	CU-Trx	25.0	0.10	--	--	--	--	--	--	--	--
93	5	"	496+93	31.0-33.0	A-6(14)	Unconf	--	0.44	--	--	--	--	--	--	--	--
93	6	"	496+93	31.0-33.0	A-6(14)	CU-Trx	--	1.52	--	--	--	--	--	--	--	--
93	7	"	496+93	51.0-53.0	A-6(14)	Unconf	--	0.77	--	--	--	--	--	--	--	--
93	8	"	496+93	51.0-53.0	A-6(14)	CU-Trx	--	3.50	--	--	--	--	--	--	--	--
93	9	"	496+93	51.0-53.0	A-6(14)	CU-Trx	--	4.80	--	--	--	--	--	--	--	--
93	10	"	496+93	31.0-33.0	A-6(14)	CU-Trx	--	2.09	1.20	1.20	0.180	--	2.72	--	--	--
93	11	"	496+93	16.0-18.0	A-4(7)	Unconf	--	0.37	--	--	--	--	--	--	--	--
93	12	"	496+93	16.0-18.0	A-4(7)	CU-Trx	--	1.40	--	--	--	--	--	--	--	--
94	2	"	498+55	23.0-25.0	A-4(7)	CU-Trx	--	2.05	--	--	--	--	--	--	--	--
94	3	"	498+55	23.0-25.0	A-4(7)	CU-Trx	--	1.22	1.00	2.00	0.110	--	2.71	--	--	--
94	4	"	498+55	23.0-25.0	A-4(7)	CU-Trx	--	1.80	--	--	--	--	--	--	--	--
97	1	"	519+95	13.5-18.5	A-7-6(66)	--	--	--	--	--	--	--	--	--	--	--
99	1	US-50	1070+00	1.0- 5.0	A-7-6	--	--	--	--	--	--	--	--	98.0	20.0	[illegible]
102	1	"	1135+05	13.0-15.0	A-4	Unconf	--	0.50	--	--	--	--	--	114.2	15.5	9.7
102	2	"	1135+05	18.0-20.0	A-6	Unconf	--	0.35	--	--	--	--	--	--	--	--
103	1-3	"	1135+00	18.0-20.0	A-6	CU-Trx	18.5	0.22	0.75	1.65	0.360	0.100	2.70	--	--	--
104	2	"	1139+00	13.0-15.0	A-6	UU-Trx	--	0.80	--	--	--	--	--	--	--	--
105	1	"	1139+05	8.0-10.0	A-4(4)	Unconf	--	0.74	--	--	--	--	--	--	--	--
105	2	"	1139+05	13.0-15.0	A-6	Unconf	--	0.27	--	--	--	--	--	--	--	--
106	1	"	1139+00	7.0- 9.0	A-4	Unconf	--	0.65	--	--	--	--	--	--	--	--
107	1	"	1204+50	1.0- 4.0	A-6	--	--	--	--	--	--	--	--	--	--	--
108	2	"	1212+00	3.0- 5.0	A-6	UU-Trx	--	0.85	--	--	--	--	--	104.8	17.2	[illegible]
109	1	"	1212+07	2.0- 4.0	A-6	UU-Trx	--	1.27	--	--	--	--	--	--	--	--
109	2	"	1212+07	2.0- 4.0	A-6	UU-Trx	--	1.38	--	--	--	--	--	--	--	--
110	1	"	1212+05	3.0- 5.0	A-6	Unconf	--	0.21	--	--	--	--	--	--	--	--
111	1	"	1215+55	1.0- 3.0	A-6	Unconf	--	0.45	--	--	--	--	--	--	--	--
114	1	SR-54	1180+74	0.0- 4.2	A-4(4)	--	--	--	--	--	--	--	2.66	108.6	16.5	4.7

APPENDIX C – Engineering Properties of Agricultural Soils of Lawrence County.

Soil Name and Map Symbol	Depth (in.)	USDA Text.	Classification USCS	AASHTO	Frags >3 in (%)	Percent Passing - Sieve # #4	#10	#40	#200	LL	PI	Clay (%)	Wet Density (g/cm3)	Permea-bility (in/hr)	Soil React. (pH)	Shrink/Swell Poten.
Ab---------- Abscota	0- 6	Sa	SP, SP-SM	A-2-4, A-3	0	95-100	95-100	50- 70	5- 15	---	NP	0-10	1.20-1.60	6.0-20	6.1-7.8	Low
	6-60	LSa, Sa	SP, SM, SP-SM	A-2-4, A-1, A-3	0	95-100	95-100	45- 75	3- 20	---	NP	0-10	1.25-1.60	6.0-20	6.1-8.4	Low
AnD-------- Alvin	0-13	SaL	SM, ML	A-4, A-2	0	100	100	80- 95	30- 60	<25	NP- 4	10-15	1.45-1.65	2.0-6.0	5.1-6.5	Low
	13-59	vf-SaL, SaL, SaCL	SM, SC, CL, ML	A-2, A-4 A-6	0	100	100	90-100	20- 80	15-38	NP-13	15-18	1.45-1.65	0.6-6.0	4.5-6.0	Low
	59-80	str-SaL to f-Sa	SM, SP, SP-SM	A-2, A-3	0- 5	75-100	90-100	70- 95	4- 35	<20	NP- 4	3-10	1.55-1.75	2.0-6.0	5.1-7.8	Low
Br--------- Bartle	0-16	SiL	CL, CL-ML	A-4, A-6	0	100	100	85-100	65- 90	20-35	5-15	15-26	1.30-1.45	0.6-2.0	5.1-7.3	Low
	16-24	SiL, SiCL	CL, CL-ML	A-4, A-6	0	100	100	90-100	70- 90	25-35	5-15	22-35	1.40-1.60	0.6-2.0	4.5-5.5	Low
	24-67	SiL, SiCL	CL	A-6, A-7	0	100	100	90-100	70- 95	30-45	10-25	22-35	1.60-1.80	<0.06	4.5-5.5	Low
	67-80	SiCL, SiL	CL	A-6, A-7	0	100	100	90-100	70- 95	30-45	10-25	22-35	1.40-1.60	0.2-0.6	5.1-7.3	Low
BdB2------- Bedford	0- 7	SiL	CL, ML	A-6, A-4	0	100	100	75-100	85- 95	30-40	5-15	10-16	1.30-1.45	0.6-2.0	3.6-6.0	Low
	7-21	SiCL	CL	A-6, A-7	0	100	95-100	75-100	85- 95	25-45	15-25	27-32	1.30-1.45	0.6-2.0	3.6-5.0	Mod
	21-39	SiCL	CL	A-6, A-7	0	100	95-100	75-100	85- 95	25-45	15-25	28-35	1.50-1.70	<0.06	3.6-5.0	Mod
	39-80	SiC, C, SiCL	CL, CH	A-7	0- 5	90-100	75- 95	70- 95	65- 90	45-55	20-30	35-55	1.30-1.50	0.2-0.6	3.6-5.0	Mod
BmC-------- Bloomfield	0- 7	LSa, Sa	SM, SP, SP-SM	A-2-4, A-3, A-4	0	100	100	70- 90	4- 40	---	NP	3-10	1.60-1.80	6.0-20	5.1-6.5	Low
	7-74	Sa, f-SaL, LSa	SM, SP, SP-SM	A-2-4, A-4, A-3	0	100	100	65- 80	4- 40	<20	NP- 3	6-18	1.60-1.80	2.0-20	5.1-6.5	Low
	74-80	Sa	SP, SM, SP-SM	A-2-4, A-3	0	100	100	65- 80	4- 30	---	NP	3-18	1.70-1.90	6.0-20	5.1-6.5	Low
Bo--------- Bonnie	0- 9	SiL	CL	A-4, A-6	0	100	100	95-100	90-100	27-34	8-12	18-25	1.20-1.40	0.6-2.0	6.6-7.3	Low
	9-36	SiL	CL	A-4, A-6	0	100	100	95-100	90-100	27-34	8-12	18-25	1.40-1.60	0.2-2.0	4.5-5.5	Low
	36-60	SiL	CL	A-4, A-6	0	100	100	95-100	90-100	27-34	8-12	18-25	1.45-1.65	0.2-2.0	5.1-7.3	Low
Bu--------- Burnside	0-16	SiL	ML, CL	A-4	0-10	100	100	80- 95	75- 95	20-35	2-10	20-27	1.20-1.40	0.6-2.0	4.5-6.0	Low
	16-42	vch-L, ch-SiL	SC, GC, SM, GM	A-2, A-4	0-60	15- 80	30- 60	30- 50	26- 45	<20	NP-10	15-25	1.40-1.60	0.6-2.0	5-5.5	Low
	42	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---

APPENDIX C – Continued

Soil Name and Map Symbol	Depth (in)	USDA Text	Classification USCS	Classification AASHTO	Frags >3 in (%)	Percent Passing – Sieve # #4	#10	#40	#200	LL	PI	Clay (%)	Wet Density (g/cm3)	Permea- bility (in/hr)	Soil React. (pH)	Shrink /Swell Poten
CcC2, CcD2–																
Caneyville	0-14	SiL	ML, CL, CL-ML	A-4, A-6	0-3	90-100	85-100	75-100	60- 95	20-35	2-12	10-25	1.20-1.40	0.6-2.0	4.5-7.3	Low
	14-33	SiC, C, SiCL	CH, CL	A-7	0-3	90-100	85-100	75-100	65-100	42-70	20-45	36-60	1.35-1.60	0.2-0.6	4.5-7.3	Mod
	33	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
CfF–																
Caneyville	0- 9	SiL	ML, CL, CL-ML	A-4, A-6	0-3	90-100	85-100	75-100	60- 95	20-35	2-12	10-25	1.20-1.40	0.6-2.0	4.5-7.3	Low
	9-24	SiC, C, SiCL	CH, CL	A-7	0-3	90-100	85-100	75-100	65-100	42-70	20-45	36-60	1.35-1.60	0.2-0.6	4.5-7.3	Mod
	24-34	C, SiC	CH	A-7	0-3	90-100	85-100	75-100	65-100	50-75	30-45	40-60	1.35-1.60	0.2-0.6	5.6-7.8	Mod
	34	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Gilpin	0- 6	SiL	CL, CL-ML	A-4, A-6	0- 5	80- 95	75- 90	70- 85	65- 80	20-40	4-15	15-27	1.20-1.40	0.6-2.0	3.6-5.5	Low
	6-33	ch-L, vch-SiL, vsh-SiCL	GC, GM-GC	A-1, A-2, A-4, A-6	0-35	25- 55	20- 50	15- 45	15- 40	20-40	4-15	15-35	1.20-1.50	0.6-2.0	3.6-5.5	Low
	33	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cg–																
Chagrin	0-10	L	ML, CL, CL-ML	A-4	0	95-100	85-100	80-100	70- 90	20-35	2-10	10-27	1.20-1.40	0.6-2.0	5.6-7.3	Low
	10-42	SiL, L, SaL	ML, SM	A-4, A-2, A-6	0	90-100	75-100	55- 90	30- 80	20-40	NP-14	18-30	1.20-1.50	0.6-2.0	5.6-7.3	Low
	42-60	str-Si to f-Sa	ML-SM	A-4, A-2	0	85-100	75-100	50- 85	15- 80	20-40	NP-10	5-25	1.20-1.40	0.6-2.0	5.6-7.3	Low
CrB, CrC2, CrE2																
Crider	0- 7	SiL	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	85-100	25-35	4-12	15-27	1.20-1.40	0.6-2.0	5.1-7.3	Low
	7-33	SiL, SiCL	CL, ML, CL-CL	A-7, A-6, A-4	0	100	95-100	90-100	85-100	25-42	4-20	18-35	1.20-1.45	0.6-2.0	5.1-7.3	Low
	33-80	SiC, C, SiCL	CL, CH	A-7, A-6	0- 5	85-100	75-100	70-100	60-100	35-65	15-40	30-60	1.20-1.55	0.6-2.0	4.5-6.5	Mod
CsD2–																
Crider	0- 7	SiL	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	85-100	25-35	4-12	15-27	1.20-1.40	0.6-2.0	5.1-7.3	Low
	7-36	SiL, SiCL	CL, ML, CL-CL	A-7, A-6, A-4	0	100	95-100	90-100	85-100	25-42	4-20	18-35	1.20-1.45	0.6-2.0	5.1-7.3	Low
	36-80	SiC, C, SiCL	CL, CH	A-7, A-6	0- 5	85-100	75-100	70-100	60-100	35-65	15-40	30-60	1.20-1.55	0.6-2.0	4.5-6.5	Mod
Caneyville	0-11	SiL	ML, CL, CL-ML	A-4, A-6	0- 3	90-100	85-100	75-100	60- 95	20-35	2-12	10-25	1.20-1.40	0.6-2.0	4.5-7.3	Low
	11-26	SiC, C, SiCL	CH, CL	A-7	0- 3	90-100	85-100	75-100	65-100	42-70	20-45	36-60	1.35-1.60	0.2-0.6	4.5-7.3	Mod
	26-38	C, SiC	CH	A-7	0- 3	90-100	85-100	75-100	65-100	50-75	30-45	40-60	1.35-1.60	0.2-0.6	5.6-7.8	Mod
	38	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---

APPENDIX C – Continued

Soil Name and Map Symbol	Depth (in.)	USDA Text	Classification USCS	Classification AASHTO	Frags >3 in (%)	Percent Passing – Seive # #4	#10	#40	#200	LL	PI	Clay (%)	Wet Density (g/cm³)	Permea-bility (in/hr)	Soil React (pH)	Shrink/Swell Poten
CwD2------																
Crider	0-17	SiL	ML, CL	A-4, A-6	0	100	95-100	90-100	85-100	25-35	3-11	20-27	1.10-1.30	0.6-2.0	5.1-6.5	Low
	17-29	SiL, SiCL	CL	A-7, A-6, A-4	0	100	95-100	90-100	85-100	30-45	8-22	25-35	1.20-1.40	0.6-2.0	5.1-6.5	Low
	29-62	chty-SiCL, chty-SiC, chty-C	GC, CL, CH, SC	A-7	5-10	50- 85	50- 75	40- 70	35- 70	44-65	22-40	35-65	1.40-1.60	0.6-2.0	5.1-6.5	Mod
Frederick	0-13	SiL	ML, CL, CL-ML	A-4, A-6	0- 5	80-100	75-100	75- 95	75- 95	<35	NP-15	13-23	1.25-1.50	2.0-6.0	4.5-6.0	Low
	13-32	SiL, SiCL, chty-SiCL	CL, CL-ML	A-6, A-7, A-4	0- 5	80-100	60-100	55-100	50- 95	20-45	5-25	20-40	1.40-1.65	0.6-2.0	4.5-6.0	Mod
	32-80	SiC, C, chty-C	CH, MH	A-7	0- 5	80-100	65-100	65-100	65-100	50-70	20-40	40-75	1.40-1.65	0.6-2.0	4.5-5.5	Mod
EbC2------																
Ebal	0- 7	SiL	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-100	70- 90	25-35	5-15	20-28	1.35-1.50	0.6-2.0	4.5-6.0	Low
	7-22	ch-SiL, vch-SiCL	CL, GC	A-6, A-7	0- 3	60- 70	50- 75	45- 70	40- 65	30-45	12-20	20-30	1.40-1.60	0.6-2.0	4.5-6.0	Mod
	22-27	ch-SiC, vch-C	CL, CH, GC	A-7	3-15	60- 70	50- 70	45- 70	40- 65	40-55	20-30	38-50	1.45-1.65	0.2-0.6	4.5-5.0	Mod
	27-50	C	CH	A-7	0- 3	95-100	90-100	80-100	70- 95	60-75	35-45	55-70	1.55-1.75	<0.06	4.5-5.0	High
	50-80	WBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
EdD-------																
Ebal	0- 3	SiL	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-100	70- 90	25-35	5-15	20-28	1.35-1.50	0.6-2.0	4.5-6.0	Low
	3-27	ch-SiL, vch-SiCL	CL, GC	A-6, A-7	0- 3	60- 70	50- 75	45- 70	40- 65	30-45	12-20	20-30	1.40-1.60	0.6-2.0	4.5-5.0	Mod
	27-56	C	CH	A-7	0- 3	95-100	90-100	80-100	70- 95	60-75	35-45	55-70	1.55-1.75	<0.06	4.5-5.0	High
	56-80	UBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Wellston	0- 5	SiL	ML	A-4	0	95-100	90-100	85-100	70- 95	25-35	3-10	13-27	1.30-1.50	0.6-2.0	5.1-6.5	Low
	5-40	SiL, SiCL	CL, CL-ML	A-6, A-4	0- 5	75-100	70-100	60- 95	60- 90	25-40	5-20	18-35	1.30-1.65	0.6-2.0	4.5-6.0	Low
	40-60	SiL, L, gr-L	CL-ML, CL, SC, SM-SC	A-4, A-6	0-10	65- 90	65- 90	60- 90	40- 65	20-35	5-15	15-30	1.30-1.60	0.6-2.0	4.5-6.0	Low
	60	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
EiB2------																
Elkins-ville Variant	0- 8	L	ML, CL-ML, CL	A-4	0	100	100	75- 95	60- 75	<25	2- 8	7-18	1.25-1.40	0.6-2.0	5.6-7.3	Low
	8-71	L, CL	ML, CL-ML, SM-SC, SM	A-4	0	90-100	85-100	65-100	45- 85	<25	2- 8	12-18	1.35-1.55	0.6-2.0	4.5-6.0	Low
	71-80	gr-L, SiL	CL, ML-CL, SM-SC, SM	A-6, A-4	0-10	70- 90	65- 85	55- 80	40- 75	<30	3-11	12-20	1.35-1.55	0.6-2.0	4.5-6.0	Low

APPENDIX C – Continued

Soil Name and Map Symbol	Depth (in.)	USDA Text	Classification USCS	Classification AASHTO	Frags >3 in (%)	Percent Passing – Sieve # #4	#10	#40	#200	LL	PI	Clay (%)	Wet Density (g/cm3)	Permea-bility (in/hr)	Soil React (pH)	Shrink/Swell Poten
FrC2------ Frederick	0-14	SiL	ML, CL, CL-ML	A-4, A-6	0- 5	80-100	75-100	75- 95	75- 90	<35	NP-15	13-23	1.25-1.50	2.0-6.0	4.5-6.0	Low
	14-19	SiL, SiCL, chty-SiCL	CL, CL-ML	A-6, A-7, A-4	0- 5	80-100	60-100	55-100	50- 95	20-45	5-25	20-40	1.40-1.65	0.6-2.0	4.5-6.0	Mod
	19-54	C, CL, SiC	CH, MH	A-7	0- 5	90-100	85-100	70-100	60- 95	60-85	30-55	50-85	1.40-1.65	0.6-2.0	4.5-5.5	High
	54-80	C, SiC	CH	A-7	0- 5	90-100	85-100	75-100	65- 95	60-85	30-55	45-80	1.40-1.65	0.6-2.0	4.5-5.5	Mod
FtD3------ Frederick	0-14	SiCL	CL, CL-ML	A-4, A-6, A-7	0- 5	80-100	75-100	70- 95	50- 95	20-45	5-25	27-35	1.30-1.60	0.6-2.0	4.5-6.0	Low
	14-28	SiC, C, chty-C	CH, CL	A-7	0- 5	80-100	65-100	65-100	65-100	50-70	20-40	40-75	1.40-1.65	0.6-2.0	4.5-5.5	Mod
	28-33	C, CL, SiC	CH, CL	A-7	0- 5	90-100	85-100	70-100	60- 95	60-85	30-55	50-85	1.40-1.65	0.6-2.0	4.5-5.5	High
	33-80	C, SiC	CH	A-7	0- 5	90-100	85-100	75-100	65- 95	60-85	30-55	45-80	1.40-1.65	0.6-2.0	4.5-5.5	Mod
FwC2------ Frederick	0- 9	SiL	ML, CL, CL-ML	A-4, A-6	0- 5	80-100	75-100	75- 95	75- 90	<35	NP-15	13-23	1.25-1.50	2.0-6.0	4.5-6.0	Low
	9-36	SiC, C, chty-C	CH, CL	A-7	0- 5	80-100	65-100	65-100	65-100	50-70	20-40	40-75	1.40-1.65	0.6-2.0	4.5-5.5	Mod
	36-80	C, SiC	CH	A-7	0- 5	90-100	85-100	75-100	65- 95	60-85	30-55	45-80	1.40-1.65	0.6-2.0	4.5-5.5	Mod
Crider	0- 7	SiL	ML, CL	A-4, A-6	0	100	95-100	90-100	85-100	25-35	3-11	20-27	1.10-1.30	0.6-2.0	5.1-6.5	Low
	7-16	SiL, SiCL	CL	A-7, A-6, A-4	0	100	95-100	90-100	85-100	30-45	8-22	25-35	1.20-1.40	0.6-2.0	5.1-6.5	Low
	16-59	chty-SiCL, chty-SiC, chty-C	GC, CL, CH, SC	A-7	5-10	50- 85	50- 75	40- 70	35- 70	44-65	22-40	35-65	1.40-1.60	0.6-2.0	5.1-6.5	Mod
	59-70	SiC, C	CL, CH	A-7	0- 5	85-100	75-100	70-100	60-100	41-70	25-45	50-70	1.30-1.60	0.6-2.0	5.1-6.5	Mod
GnC------- Gilpin	0- 9	SiL	CL, CL-ML	A-4, A-6	0- 5	80- 95	75- 90	70- 85	65- 80	20-40	4-15	15-27	1.20-1.40	0.6-2.0	3.6-5.5	Low
	9-26	ch-SiL, SiL	GC, SC, CL, CL-ML	A-2, A-4, A-6	0-30	50- 95	45- 90	35- 85	30- 80	20-40	4-15	18-35	1.20-1.50	0.6-2.0	3.6-5.5	Low
	26-34	WBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Crider	0-12	SiL	ML, CL	A-4, A-6	0	100	95-100	90-100	85-100	25-35	3-11	20-27	1.10-1.30	0.6-2.0	5.1-6.5	Low
	12-22	SiL, SiCL	CL	A-7, A-6, A-4	0	100	95-100	90-100	85-100	30-45	8-22	25-35	1.20-1.40	0.6-2.0	5.1-6.5	Low
	22-80	chty-SiCL, chty-SiC, chty-C	GC, CL, CH, SC	A-7	5-10	50- 85	50- 75	40- 70	35- 70	44-65	22-40	35-65	1.40-1.60	0.6-2.0	5.1-6.5	Mod

APPENDIX C - Continued

Soil Name and Map Symbol	Depth (in)	USDA Text	Classification USCS	AASHTO	Frags >3 in (%)	Percent Passing - Sieve # #4	#10	#40	#200	LL	PI	Clay (%)	Wet Density (g/cm^3)	Permea-bility (in/hr)	Soil React (pH)	Shrink /Swell Poten
GwF-------- Gilpin	0-17	ch-SiL	GC, SC, CL CL-ML	A-2, A-4 A-6	0-30	50- 90	45- 85	35- 75	30- 70	20-40	4-15	15-27	1. 20-1. 40	0 6-2. 0	3 6-5 5	Low
	17-34	ch-L, vch-SiL, sh-SiCL	GC, GM-GC	A-1, A-2 A-4, A-6	0-35	25- 55	20- 50	15- 45	15- 40	20-40	4-15	15-35	1. 20-1. 50	0 6-0 2	3 6-5 5	Low
	34	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Weikert	0- 5	ch-SiL	GM, ML, SM	A-1, A-2 A-4	0-10	35- 70	35- 70	25- 65	20- 55	30-40	4-10	15-27	1. 20-1. 40	2 0-6 0	4 5-6 0	Low
	5-17	WBR	GM, GP-GM	A-1, A-2	0-20	15- 60	10- 55	5- 45	5- 35	28-36	3- 9	15-27	1 20-1. 40	2. 0-6. 0	4 5-6 0	Low
	17	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Wallston	0-10	Sil	ML	A-4	0	95-100	90-100	85-100	70- 95	25-35	3-10	13-27	1. 30-1. 50	0. 6-2 0	5 1-6 3	Low
	10-45	Sil, SiCL	CL, CL-ML	A-6, A-4	0- 5	75-100	70-100	60- 95	60- 90	25-40	5-20	18-35	1. 30-1 65	0. 6-2. 0	4 5-6 0	Low
	45-54	WBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	54	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hn -------- Haymond	0-12	SiL	ML	A-4	0	100	100	90-100	80- 90	27-36	4-10	10-18	1. 30-1. 45	0. 6-2. 0	5 6-7 3	Low
	12-42	SiL	ML	A-4	0	100	100	90-100	80- 90	27-36	4-10	10-18	1. 30-1 45	0 6-2. 0	5 6-7 3	Low
	42-69	f-SaL, SiL, L	ML, SM	A-4	0	95-100	90-100	80-100	35- 90	27-36	4-10	10-18	1. 30-1 45	0 6-2. 0	6 1-7 3	Low
HrA-------- Henshaw	0- 8	SiL	ML, CL, CL-ML	A-4	0	95-100	95-100	90-100	80-100	20-35	3-10	12-27	1. 20-1 40	0 6-2 0	5 6-6 5	Low
	8-30	SiCL, SiL	CL, ML	A-6, A-4	0	95-100	95-100	95-100	85-100	30-40	8-18	18-34	1. 20-1 40	0 2-0 6	5 1-7. 3	Low
	30-60	SiL, SiCL	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	85-100	75-100	25-40	5-15	15-34	1. 20-1. 40	0. 2-0 6	6 6-8 4	Low
Hs---------- Hoosier-ville	0-10	SiL	CL	A-4, A-6	0	100	100	90-100	70- 90	27-36	8-15	10-18	1. 30-1 45	0 6-2 0	4 5-7 3	Low
	10-17	SiL	CL	A-4, A-6	0	100	100	90-100	80- 90	27-36	8-15	16-24	1 35-1 50	0. 6-2. 0	4 5-6 0	Low
	17-75	SiCL, SiL	CL, Ch	A-6, A-7	0	100	100	90-100	65- 95	30-54	20-32	26-32	1 40-1 60	0. 2-0. 6	4 5-6 0	Mod
	75-80	SiL	CL	A-4, A-6	0	100	100	90-100	70- 90	27-36	8-15	10-18	1 35-1 55	0 2-0 6	4 5-7 3	Low
HsB2-------- Hosmer	0- 7	SiL	ML, CL-ML CL	A-4	0	100	100	90-100	70- 90	<25	3-10	10-17	1 20-1 40	0 6-2. 0	4 5-6 5	Low
	7-28	SiL, SiCL	CL, CL-ML ML	A-4, A-6	0	100	100	90-100	70- 95	25-35	5-15	24-30	1 30-1 50	0. 6-2. 0	4 5-5 5	Mod
	28-80	SiL, SiCL, C	CL, CL-ML ML		0	100	100	90-100	70- 95	20-30	5-15	16-26	1. 60-1. 70	<0 06	4 5-6 0	Low
MuB2------- Markland	0- 7	SiCL	CL	A-6, A-7	0	100	100	95-100	65- 95	30-45	10-20	28-40	1 35-1 50	0 2-0 6	5 1-7 3	Mod
	7-28	SiC, C, SiCL	CL, CH	A-7	0	100	100	95-100	90- 95	45-60	19-32	40-55	1 55-1 70	0 06-. 2	5 1-7 3	High
	28-60	str-C to SiCl	CL, CH	A-7	0	100	100	90-100	75- 95	40-55	15-25	35-50	1 55-1 70	0. 06-. 2	7 4-8 4	High

APPENDIX C - Continued

Soil Name and Map Symbol	Depth (in.)	USDA Text	Classification		Frags >3 in (%)	Percent Passing - Sieve #				LL	PI	Clay (%)	Wet Density (g/cm^3)	Permea-bility (in/hr)	Soil React. (pH)	Shrin /Swell Poten
			USCS	AASHTO		#4	#10	#40	#200							
MhA------- McGary	0- 8	SiCL	CL-ML, CL	A-4, A-6	0	100	100	70-100	70- 90	25-36	5-15	22-27	1.35-1.50	0.6-2.0	6.6-7.3	Low
	8-80	SiC, SiCL, SiL	CL, CH	A-7	0	100	100	95-100	90-100	46-58	24-32	35-50	1.60-1.75	<0.20	5.6-7.8	High
MuA-------- Muren	0-10	SiL	CL, CL-ML	A-4, A-6	0	100	100	90-100	70- 90	25-35	5-15	18-27	1.25-1.40	0.6-2.0	5.1-6.0	Low
	10-80	SiCL, SiL	CL	A-6, A-7	0	100	100	90-100	80- 95	35-50	15-30	22-30	1.35-1.50	0.2-0.6	5.1-6.0	Mod
Ne--------- Newark	0- 7	SiL	ML, CL, CL-ML	A-4	0	95-100	90-100	80-100	55- 95	<32	NP-10	7-27	1.20-1.40	0.6-2.0	5.6-7.8	Low
	7-26	SiL, SiCL	ML, CL, CL-ML	A-4, A-6, A-7	0	75-100	90-100	85-100	70- 95	22-42	3-20	18-35	1.20-1.45	0.6-2.0	5.6-7.8	Low
	26-60	SiL, SiCL	ML, CL, CL-ML	A-4, A-6, A-7	0- 3	75-100	70-100	65-100	55- 95	22-42	3-20	12-40	1.30-1.50	0.6-2.0	5.6-7.8	Low
No--------- Nolin	0-10	SiL	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	80-100	25-40	5-18	12-35	1.20-1.40	0.6-2.0	5.6-8.4	Low
	10-60	SiL, SiCL	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	85-100	75-100	25-46	5-23	18-35	1.25-1.50	0.6-2.0	5.6-8.4	Low
PeB, PeC2-- Pekin	0-12	SiL	CL, CL-ML	A-4, A-6	0	100	100	85-100	65-100	20-30	5-15	15-26	1.30-1.45	0.6-2.0	5.6-7.3	Low
	12-31	SiL, SiCL	CL	A-6	0	100	100	90-100	70-100	25-40	10-20	25-35	1.40-1.60	0.6-2.0	4.5-5.5	Low
	31-77	SiL, SiCL	CL, CL-ML	A-4, A-6	0	100	100	88- 98	65- 90	25-35	5-15	22-30	1.60-1.80	<0.06	4.5-5.5	Low
	77-80	str-f-SaL to SiCL	CL, CL-ML	A-4, A-6	0	100	100	80- 95	50- 85	20-40	5-15	20-34	1.40-1.60	0.6-2.0	4.5-7.3	Low
Fh--------- Petrolia	0- 9	SiCL	CL	A-6, A-7	0	100	95-100	90-100	80-100	30-45	12-20	27-35	1.20-1.40	0.2-0.6	5.6-6.0	Mod
	9-60	SiCL, SiL	CL	A-6, A-7, A-4	0	100	95-100	80-100	60-100	20-45	8-20	20-35	1.40-1.60	0.2-0.6	6.1-7.3	Mod
PnB-------- Princeton	0- 8	SaL	SM, SC, ML, CL	A-4, A-2-4	0	100	100	60- 85	30- 55	<25	NP-10	12-20	1.35-1.50	0.6-2.0	5.6-7.3	Low
	8-40	SaCL, f-SaL	SC, CL	A-6	0	100	100	70- 90	35- 70	25-35	10-15	18-25	1.40-1.55	0.6-2.0	5.1-6.5	Low
	40-52	str-Lf-Sa to L	SC, SM-SC, CL, CL-ML	A-4, A-6, A-2-4, A-2-6	0	100	100	60- 90	30- 70	15-25	5-15	8-18	1.40-1.55	2.0-6.0	5.1-7.3	Low
	52-80	str-f-Sa to Si	SM, ML, CL-ML	A-2-4, A-4	0	100	100	65- 90	20- 55	<20	NP- 5	4-10	1.45-1.60	2.0-6.0	6.1-8.4	Low

APPENDIX C – Continued

Soil Name and Map Symbol	Depth (in)	USDA Text	Classification USCS	AASHTO	Frags >3 in (%)	Percent Passing – Sieve # #4	#10	#40	#200	LL	PI	Clay (%)	Wet Density (g/cm3)	Permea-bility (in/hr)	Soil React (pH)	Shrink /Swell Poten
PnB-------- Alvin	0-14	LSa	SM	A-2	0	100	100	50- 75	15- 30	<20	NP- 4	5-10	1.50-1.70	6.0-20	5.1-6.5	Low
	14-48	vf-SaL, SaL, SaCL	SM, SC, CL, ML	A-2, A-4 A-6	0	100	100	90-100	20- 80	15-38	NP-13	15-18	1.45-1.65	0.6-6.0	4.5-6.0	Low
	48-70	str-SaL to f-Sa	SM, SP, SP-SM	A-2, A-3	0	95-100	90-100	70- 95	4- 35	<20	NP- 4	3-10	1.55-1.75	2.0-6.0	5.1-7.8	Low
Stendal	0-15	SiL	CL-ML, CL	A-4, A-6	0	100	100	90-100	70- 90	20-35	5-15	18-27	1.30-1.44	0.6-2.0	6.1-7.3	Low
	15-56	SiL, SiCL	CL-ML, CL	A-4, A-6	0	100	100	90-100	70- 95	20-40	5-20	18-35	1.45-1.60	0.6-2.0	5.1-6.5	Low
	56-80	SiCL, SiC	CL, CH	A-6, A-7	0	100	100	95-100	85- 95	35-55	15-30	35-50	1.55-1.65	0.06-.2	5.1-6.5	High
TyB-------- Tyner	0-15	LSa	SM	A-2-4	0	90-100	85- 95	50- 75	15- 25	---	NP	3- 8	1.40-1.55	0.6-20.	5.1-7.3	Low
	15-48	Sa, LSa, L-f-Sa	SM, SP-SM	A-2-4	0	90-100	85- 95	50- 70	10- 30	---	NP	3- 8	1.45-1.60	6.0-20.	4.5-6.5	Low
	48-80	f-Sa, Sa, LSa	SM, SP-SM	A-3, A-2-4	0- 5	80- 95	75- 95	50- 70	5- 25	---	NP	1- 3	1.55-1.70	>20.	5.1-6.0	Low
Alvin	0-15	LSa	SM	A-2	0	100	100	50- 75	15- 30	<20	NP- 4	5-10	1.50-1.70	6.0-20	5.1-6.5	Low
	15-51	vf-SaL, SaL, SaCL	SM, SC, CL, ML	A-2, A-4 A-6	0	100	100	90-100	20- 80	15-38	NP-13	15-18	1.45-1.65	0.6-6.0	4.5-6.0	Low
	51-80	str-SaL to f-Sa	SM, SP, SP-SM	A-2, A-3	0	95-100	90-100	70- 95	4- 35	<20	NP- 4	3-10	1.55-1.75	2.0-6.0	5.1-7.8	Low
WbF-------- Weikert	0- 3	ch-SiL	GM, ML, SM	A-1, A-2 A-4	0-10	35- 70	35- 70	25- 65	20- 55	30-40	4-10	15-27	1.20-1.40	2.0-6.0	4.5-6.0	Low
	3-16	ch-SiL	GM, GP-GM	A-1, A-2	0-20	15- 60	10- 55	5- 45	5- 35	28-36	3- 9	15-27	1.20-1.40	2.0-6.0	4.5-6.0	Low
	16	WBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Berks	0-16	SiL	CL, ML, CL-ML	A-4	0-10	80-100	75-100	65- 85	50- 75	25-36	5-10	5-23	1.20-1.50	0.6-6.0	3.6-6.5	Low
	16-26	ch-L, vch-L, ch-SiL	GM, SM, GC, SC	A-1, A-2 A-4	0-30	40- 80	35- 70	25- 60	20- 45	25-36	5-10	5-32	1.20-1.60	0.6-6.0	3.6-6.0	Low
	26-34	ch-L, vch-L, ch-SiL	GM, SM	A-1, A-2	0-40	35- 65	25- 55	20- 40	15- 35	24-38	2-10	5-20	1.20-1.60	2.0-6.0	3.6-6.5	Low
	34	WBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Gilpin	0-16	SiL	CL, CL-ML	A-4, A-6	0- 5	80- 95	75- 90	70- 85	65- 80	20-40	4-15	15-27	1.20-1.40	0.6-2.0	3.6-5.5	Low
	16-26	ch-L, sh-SiL SiCL	GC, SC, CL, CL-ML	A-2, A-4 A-6	0-30	50- 95	45- 90	35- 85	30- 80	20-40	4-15	18-35	1.20-1.50	0.6-2.0	3.6-5.5	Low
	26-31	ch-L, vch-SiL, vsh-SiCL	GC, GM-GC	A-1, A-2 A-4, A-6	0-35	25- 55	20- 50	15- 45	15- 40	20-40	4-15	15-35	1.20-1.50	0.6-2.0	3.6-5.5	Low
	31	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---

APPENDIX C – Continued

Soil Name and Map Symbol	Depth (in)	USDA Text	Classification		Frags >3 in (%)	Percent Passing – Sieve #				LL	PI	Clay (%)	Wet Density (g/cm³)	Permea-bility (in/hr)	Soil React (pH)	Shrink/Swell Poten
			USCS	AASHTO		#4	#10	#40	#200							
WeC2, WeD2-- Wellston	0- 4	SiL	ML	A-4	0	95-100	90-100	85-100	70- 95	25-35	3-10	13-27	1.30-1.50	0.6-2.0	5.1-6.5	Low
	4-20	SiL, SiCL	CL, CL-ML	A-6, A-4	0- 5	75-100	70-100	60- 95	60- 90	25-40	5-20	18-35	1.30-1.65	0.6-2.0	4.5-6.0	Low
	20-46	SiL, L, gr-L	CL-ML, CL SC, SM-SC	A-4, A-6	0-10	65- 90	65- 90	60- 90	40- 65	20-35	5-15	15-30	1.30-1.60	0.6-2.0	4.5-6.0	Low
	46	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
WfD3------ Wellston	0- 3	SiL	ML	A-4	0	95-100	90-100	85-100	70- 95	25-35	3-10	13-27	1.30-1.50	0.6-2.0	5.1-6.5	Low
	3-32	SiL, SiCL	CL, CL-ML	A-6, A-4	0- 5	75-100	70-100	60- 95	60- 90	25-40	5-20	18-35	1.30-1.65	0.6-2.0	4.5-6.0	Low
	32-45	SiL, L, gr-L	CL-ML, CL SC, SM-SC	A-4, A-6	0-10	65- 90	65- 90	60- 90	40- 65	20-35	5-15	15-30	1.30-1.60	0.6-2.0	4.5-6.0	Low
	45-54	WBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	54	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
WgD2------ Wellston	0- 9	SiL	ML	A-4	0	75-100	90-100	85-100	70- 95	25-35	3-10	13-27	1.30-1.50	0.6-2.0	5.1-6.5	Low
	9-46	SiL, SiCL	CL, CL-ML	A-6, A-4	0- 5	73-100	70-100	60- 95	60- 90	25-40	5-20	18-35	1.30-1.65	0.6-2.0	4.5-6.0	Low
	46	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Gilpin	0- 6	SiL	CL, CL-ML	A-4, A-6	0- 5	80- 95	75- 90	70- 85	65- 80	20-40	4-15	15-27	1.20-1.40	0.6-2.0	3.6-5.5	Low
	6-23	ch-L, sh-SiL SiCL	GC, SC, CL, CL-ML	A-2, A-4 A-6	0-30	50- 95	45- 90	35- 85	30- 80	20-40	4-15	18-35	1.20-1.50	0.6-2.0	3.6-5.5	Low
	23-26	ch-L, vch-SiL, vsh-SiCL	GC, GM-GC	A-1, A-2 A-4, A-6	0-35	25- 55	20- 50	15- 45	15- 40	20-40	4-15	15-35	1.20-1.50	0.6-2.0	3.6-5.5	Low
	26	UWBR	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Wilbur	0- 7	SiL	ML, CL-ML	A-4	0	100	100	90-100	70 -90	<25	3- 7	10-17	1.30-1.45	0.6-2.0	5.6-7.3	Low
	7-60	SiL	ML, CL-ML	A-4	0	100	100	90-100	70 -90	<25	3- 7	10-17	1.30-1.45	0.6-2.0	5.6-7.3	Low

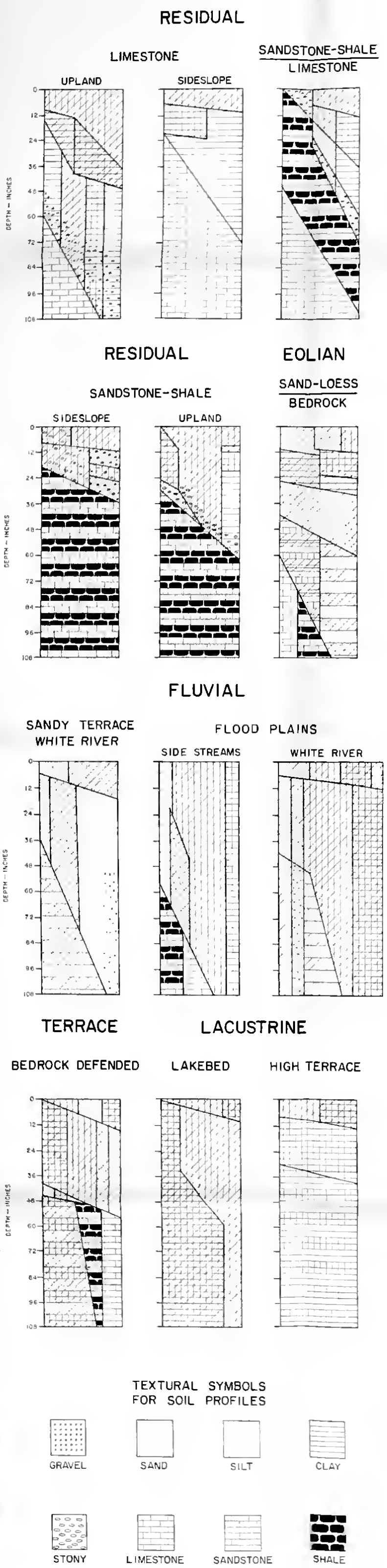
Abbreviations.

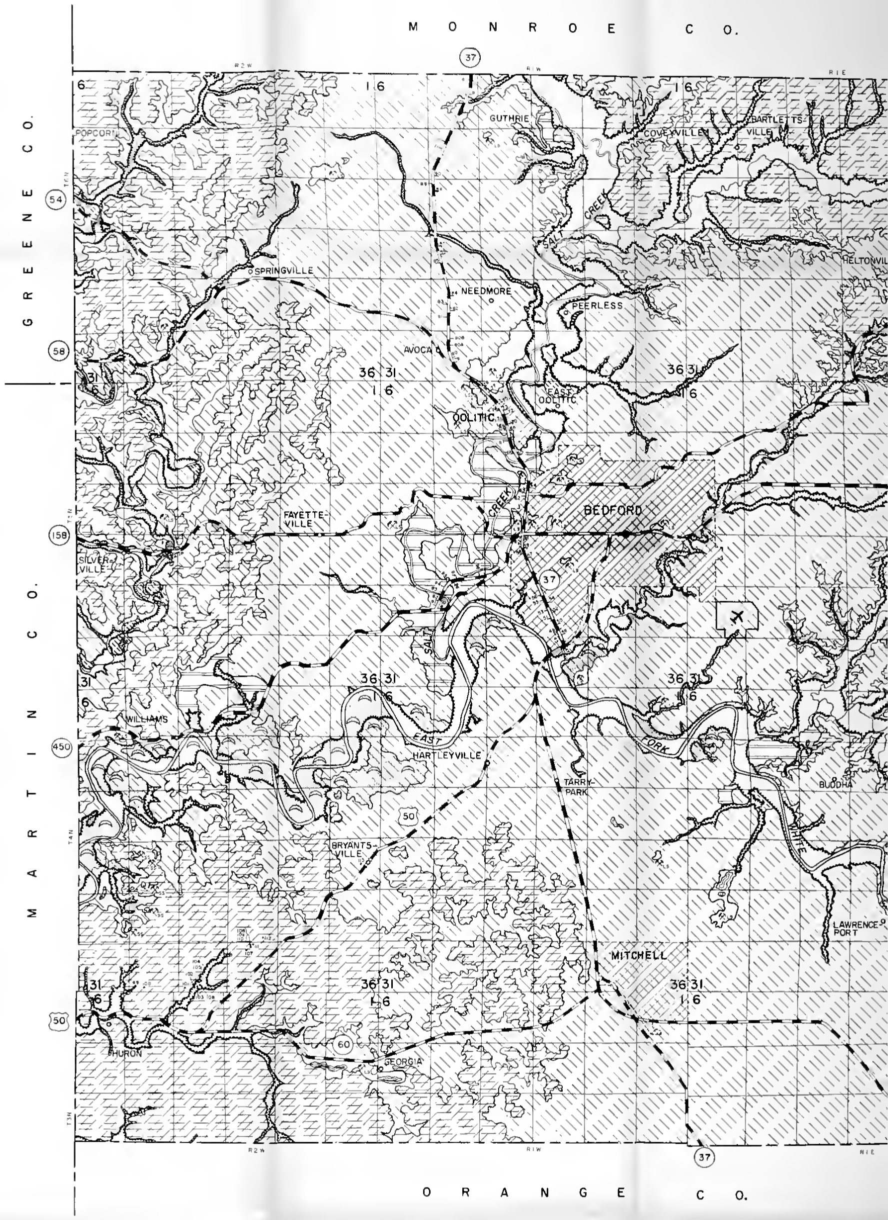
Texture:

C – Clay	f – fine	sh – shaly	gr – gravelly
Si – Silt	vf – very fine	vsh – very shaly	str – stratified
Sa – Sand	ch – channery	WBR – weathered bedrock	chty – cherty
L – Loam	vch – very channery	UWBR – unweathered bedrock	

Map symbols correspond to the agricultural soil units of the Lawrence County Soil Survey.

GENERAL SOIL PROFILES





ENGINEERING SOILS MAP

LAWRENCE COUNTY

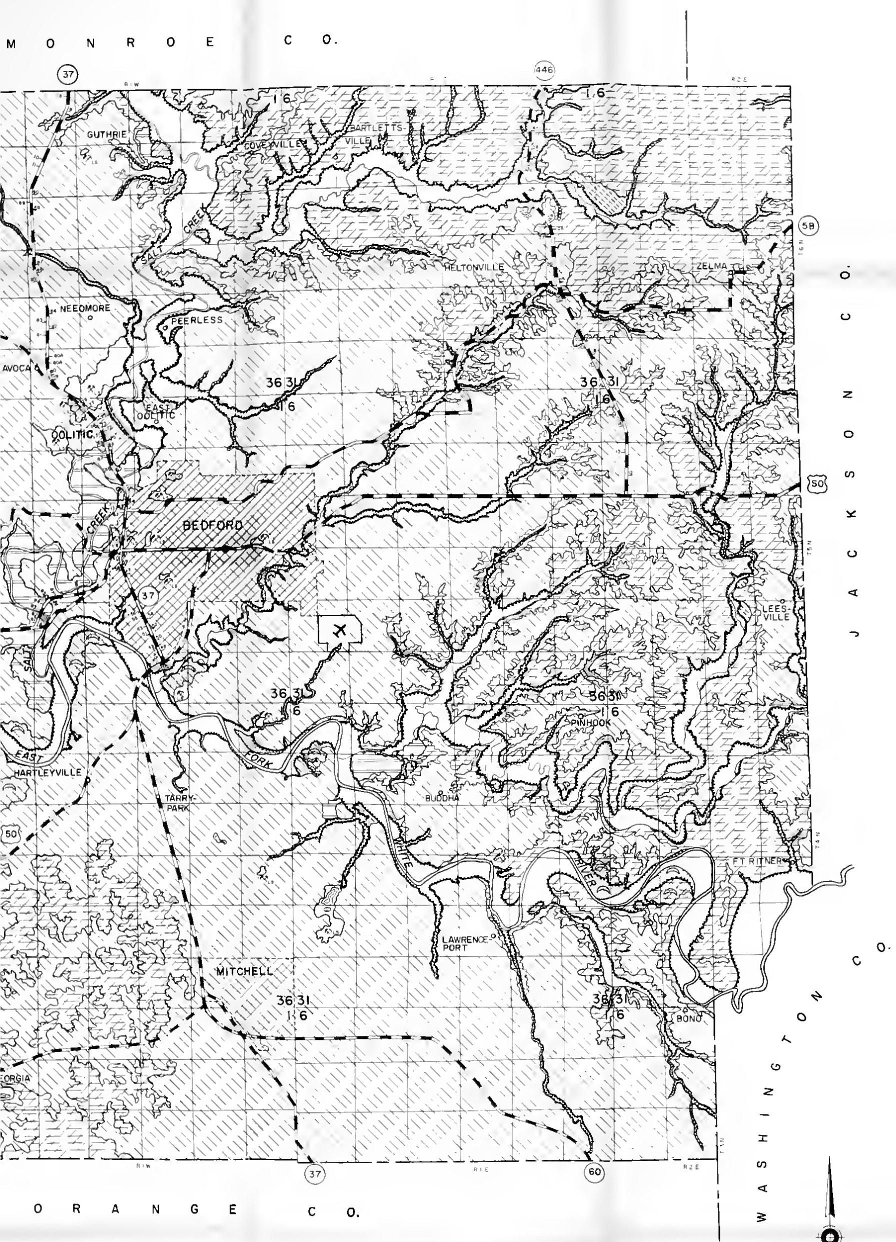
INDIANA

PREPARED FROM
1976 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY

1984

SCALE OF MILES

PREPARED UNDER THE SUPERVISION OF F T ADAMS AND R D MILES



LEGEND

PARENT MATERIALS

(GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- LIMESTONE PLAIN
- INTERBEDDED SANDSTONE AND SHALE PLATEAU
- LACUSTRINE PLAIN
- LACUSTRINE TERRACE OVER LIMESTONE
- BEDROCK DEFENDED TERRACE
- RIVER TERRACE WITH INCIPIENT DUNE DEVELOPMENT
- INCIPIENT DUNE DEVELOPMENT OVER LIMESTONE
- INCIPIENT DUNE DEVELOPMENT OVER SANDSTONE-SHALE
- FLOOD PLAIN

MISCELLANEOUS

- LS LIMESTONE QUARRY
- SS SANDSTONE QUARRY
- LAKE, POND, OR RESERVOIR
- DAM
- URBAN AREA
- MAJOR AIRPORT
- BORING SITES

TEXTURAL SYMBOLS

(SUPERIMPOSED ON PARENT MATERIAL TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

ENGINEERING SOILS MAP

LAWRENCE COUNTY

INDIANA

PREPARED FROM

1976 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY

1984

SCALE OF MILES

DRAWN BY P.E. CULLEN

COVER DESIGN BY ALDO GIORGINI